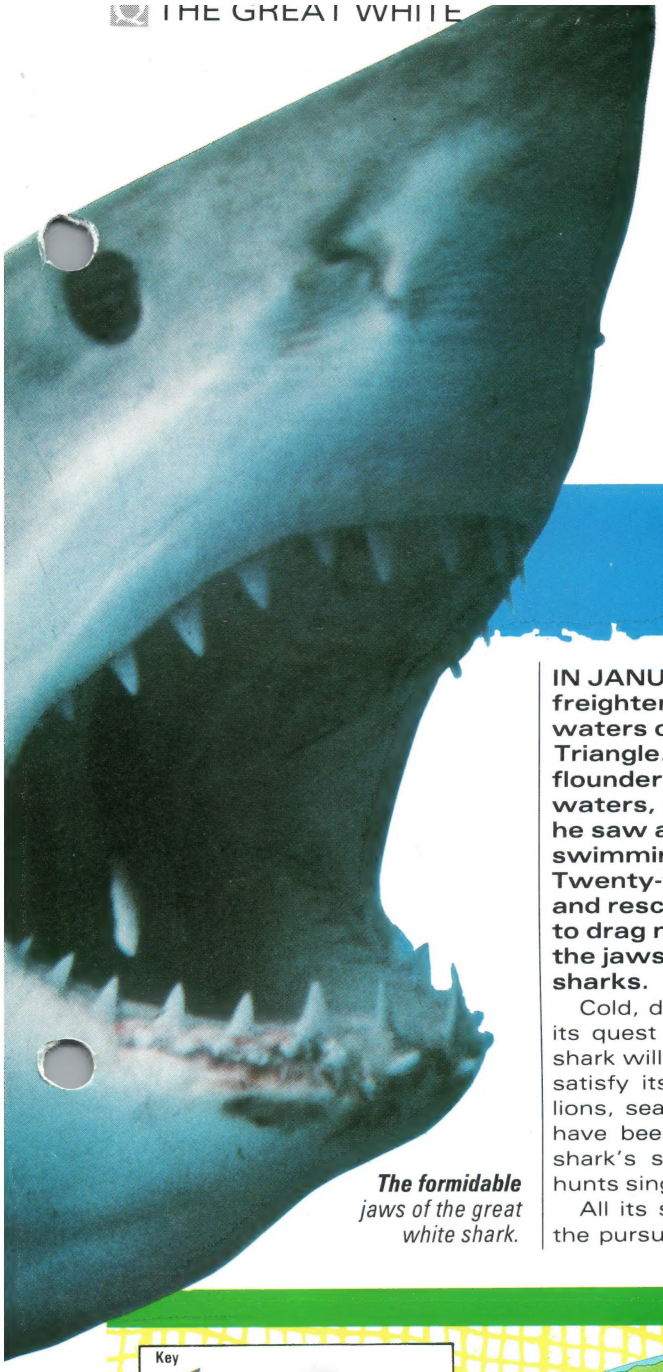
# SHARK ATTACK



***The formidable*** *jaws of the great white shark.*

**IN JANUARY 1981, AN ISRAELI freighter sank in the notorious waters of the Bermuda Triangle. As the crew floundered in the tropical waters, one of them thought he saw a family of large fish swimming towards them. Twenty-five of the sailors died and rescuers reported having to drag mutilated bodies from the jaws of the army of vicious sharks.**

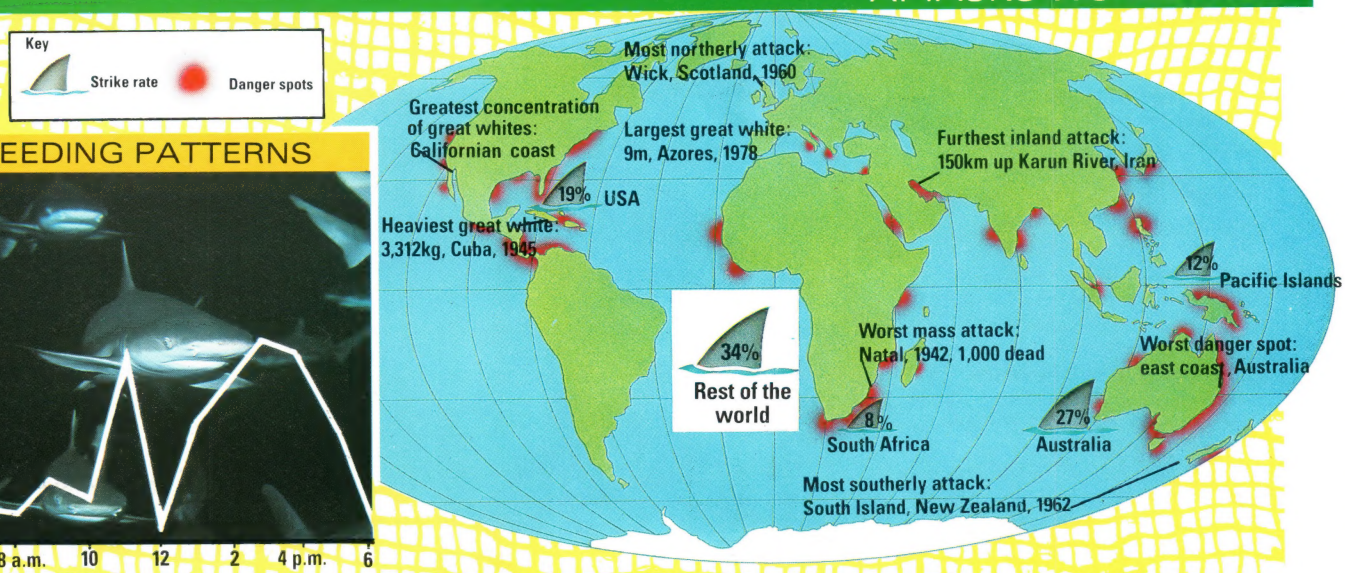
Cold, deliberate and persistent in its quest for food, the great white shark will eat just about anything to satisfy its enormous appetite. Sea lions, sea otters, fish and dolphins have been recovered from a dead shark's stomach. The great white hunts singly or in packs.

All its senses are finely tuned to the pursuit of prey. It has an excellent sense of smell, good eyesight and it can even detect the faintest electrical and pressure fields coming from its quarry. Once the target has been selected, the shark, in a sudden burst of speed, lunges towards its victim. Its snout bends upwards so that the mouth moves forward, jaws gaping wide. On inflicting the first lashing wound, the shark will often retreat briefly before returning for the kill.

## Ocean giants

Most great whites grow to 4.5 metres in length, but some larger specimens have been caught. The females are bigger than the males, and a 6.4 metre long female caught off the coast of Cuba tipped the scales at 3,312 kg – the heaviest weight recorded for a great white. In circumference, she measured an

## ATTACKS WORLDWIDE




Ron & Valerie Taylor/Ardea London

## FEEDING PATTERNS

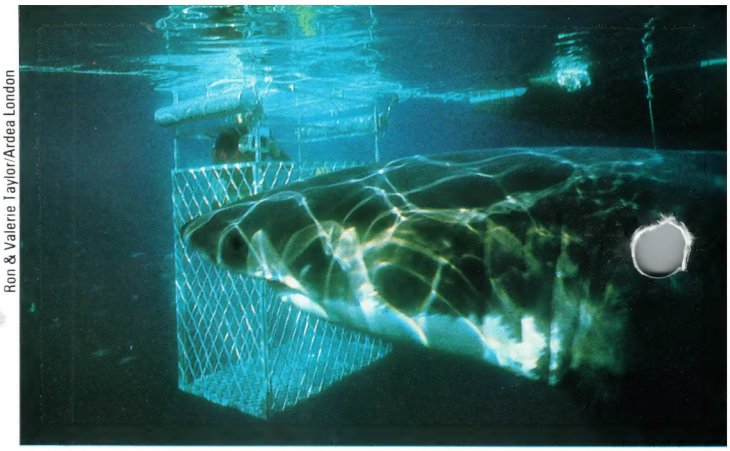



***The graph*** *shows the percentage of attacks at various times. Whether they reflect sharks' dietary patterns, or bathers' swimming times is unknown.*

P Morris/Ardea London

The majority of shark attacks occur where ocean bathing is a popular pastime. Thirty per cent of attacks worldwide are fatal. Surprisingly, this figure rises to 60 per cent in European waters. There is an average of 28 documented attacks yearly, but estimates put the number nearer to 100.

Mark Franklin



Ron & Valerie Taylor/Ardea London

***Photographing*** *the world's largest maneater is not a task for the faint-hearted. With its serrated teeth and powerful jaws, the great white is quite capable of ripping a steel cage open.*

astonishing 4.5 metres and was beached only with the aid of several trucks. Some of the great whites that got away have been estimated at more than 11 metres in length, which is almost as long as a double decker bus.

## Unfair reputation

Sharks have been around on Earth for 400 million years, with the earliest species growing to immense lengths of up to 30 metres – now recorded only as fossils. Their descendants have become a diverse group of creatures with only a few of the 344 species conforming to the image of the fierce maneater.

Apart from the great white, the two most deadly are the tiger shark and the bull shark – the latter is known to swim up rivers and attack its victims.

Because of its reputation as a maneater, there has been little scientific research on the great white. However, we do know that, like all sharks, their skeletons are made of cartilage – a tough flexible tissue – rather than bone.

They mate in the same way as many mammals. The male introduces sperm into the female's reproductive tract with his claspers. Some sharks – the great white included – give birth to live young, with up to 100 pups per litter. Others, like the whale shark, lay eggs. In some species, the babies are cannibalistic while still inside the mother – they eat their brothers and sisters before they are born.

Found in almost every ocean in the world, great whites tend to be territorial, returning to the same feeding ground every year.

## 'I SURVIVED AN ATTACK'

Spearfishing off the Great Barrier Reef, Rodney Fox was attacked by a great white. 'It was like being hit by a train,' said Fox. After surging through the water at high speed, gripped in the powerful jaws of the shark, Fox struggled free, but his injuries required 462 stitches.

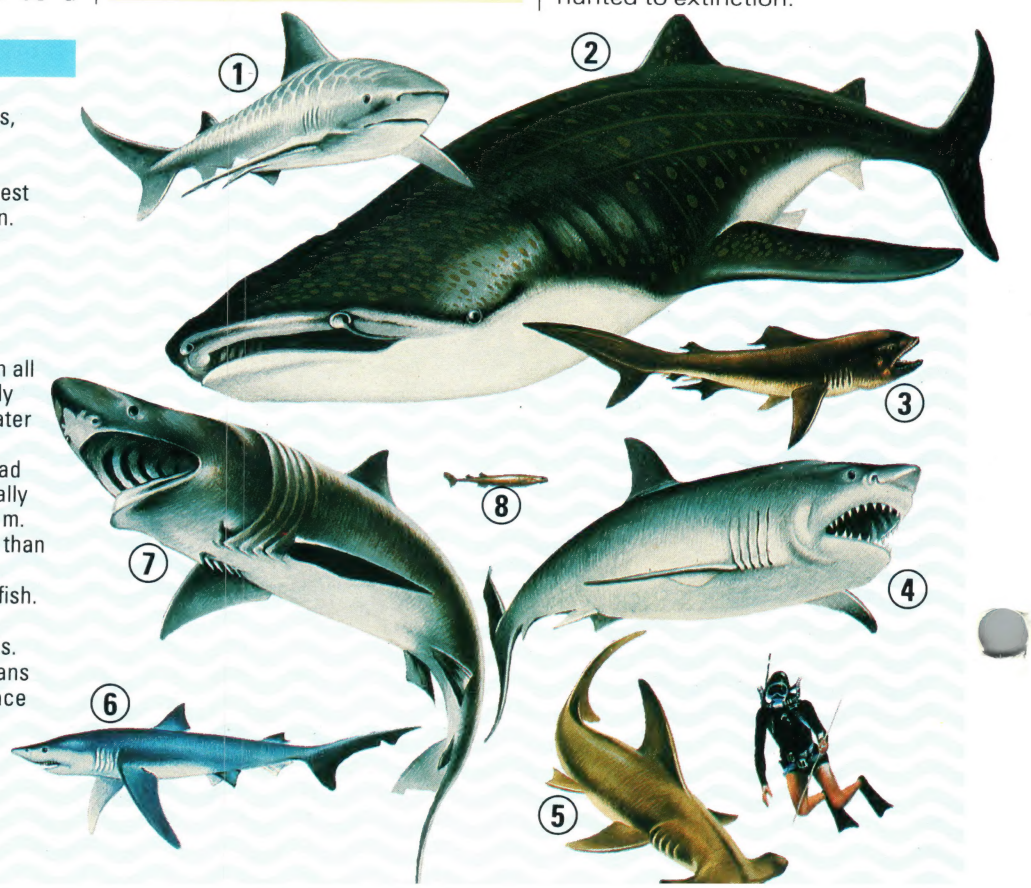

Ron & Valerie Taylor/Ardea London

## Death of the hunter

The great white's reputation as the largest potentially lethal creature in the ocean could soon be toppled. Man, its greatest enemy, stalks the shark – and without protection the great white is in danger of being hunted to extinction.

## SHARK SPOTTER

**1 Tiger shark:** eats hammerheads, turtles and garbage; maneater. Favours warm oceans.
**2 Whale shark:** biggest fish; largest caught: 12.65 m, Karachi Pakistan. Skin is a record 10 cm thick.
**3 Megamouth shark:** enormous luminous mouth. Only three specimens ever caught – first discovered in 1976 off Hawaii.
**4 Great white:** maneater, found in all warm seas and shallow bays. Only shark to lift its head above the water to view objects on the surface.
**5 Hammerhead:** oddly shaped head with nostril on each side. Potentially dangerous to man. Max length: 7 m.
**6 Blue shark:** found in more seas than any other shark. Max length: 4 m.
**7 Basking shark:** second largest fish. Enormous liver enables it to float. Filter feeder, found in most oceans.
**8 Cookiecutter:** lives in deep oceans and travels up to 7 km to the surface to feed, by tearing lumps out of whales, squid and large fish. Length: a mere 50 cm.



Bill Donohoe

THE GOOD THE BAD THE UGLY

# WONDERS OF THE DEEP

PEP/Peter David

**OVER 80 PER CENT OF LIFE ON Earth inhabits the oceans. There are almost 30,000 different species of fish and over 100,000 other varieties of marine creatures, from deadly octopuses to giant worms.**

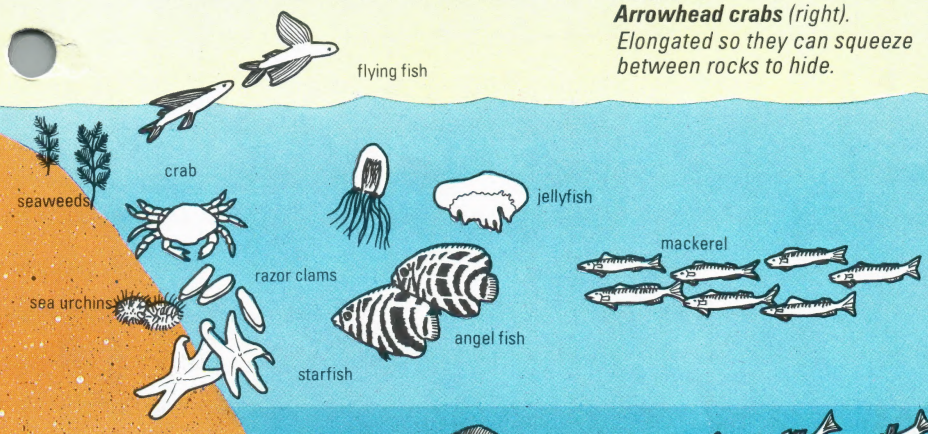
Each year, about a hundred previously unknown sea creatures are discovered in the sea.

Perfectly adapted to their environment, fish are masters of disguise. For example, the bright colours of coral reef fish may help them to blend in with the brilliant background. Along rocky shores the fish are often stone coloured. By contrast, as far as 10 km under the surface, the inhabitants have luminous lures to attract their prey in a region where no light ever reaches.

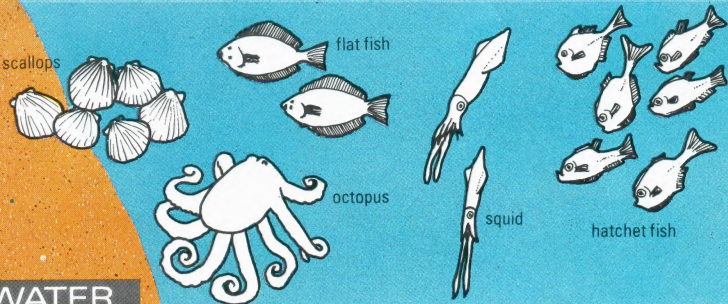
Jane Burton/Bruce Coleman Ltd

Warren Williams/Planet Earth Pictures

***Black swallower*** *(top right). Dwells in the deeps and can eat prey larger than itself.*
***Mandarin fish*** *(above). Territorial creatures, two males will fight to the death.*
***Arrowhead crabs*** *(right). Elongated so they can squeeze between rocks to hide.*




***Sunlit zone*** *0–199 m. Average temperature 16°C. The most densely populated part of the ocean. Minute plants flourish and are the basic food for a variety of animals.*

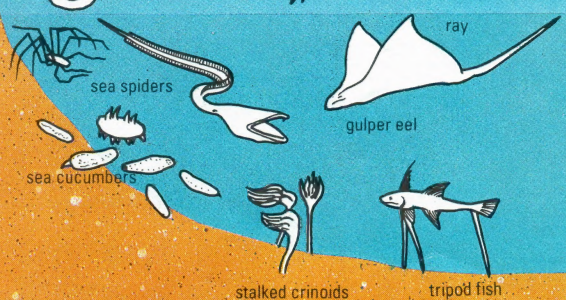



***Twilight zone*** *200–999 m. Average temperature 10°C. The animals are often brilliant reds and have enormous eyes to see in the darkness. Many fish have glowing organs to entice both mates and prey. Squid squirt a luminescent ink to divert would-be attackers.*

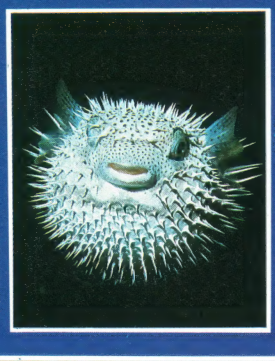
## UNDERWATER HABITAT

The ocean's surface is abundant with life, and while both invertebrates and fish extend to the deepest regions, the number of animals decreases. Below 150 metres the oceans are pitch black and cold. There are three zones (see right).

Mark Franklin




***Bathypelagic (sunless) zone*** *1–10 km. Average temperature 3°C. Creatures have small eyes as they rely mainly on sound and smell to detect prey. Often grotesque, their shape has adapted to the conditions, particularly to catching what food there is at this depth.*

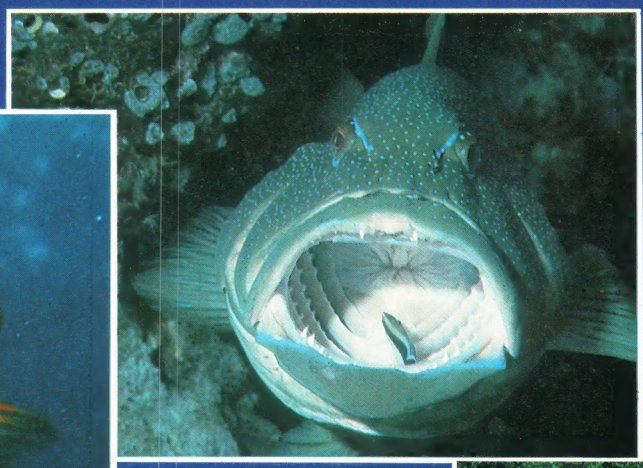


PEP/Christian Petron

***Puffer fish***. *Inflates its body and spines when threatened. A delicacy in Japan, some parts of the fish are poisonous and, if eaten by mistake, could cause death in minutes.*

***Portuguese Man O'War***. *Has a blue gas-filled float. Filaments with stinging organs trail as far as 20 metres below the surface to catch and stun its prey before devouring it.*

PEP/Flip Schulke

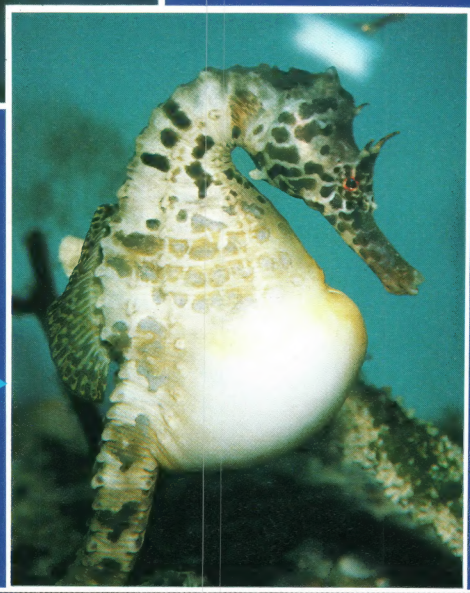


PEP/Bill Wood

***Cleaner wrasse***. *The ocean dentist feeds by sucking parasites from inside the mouth of larger fish. When finished, the wrasse may exit through the gills of his host.*

Valerie Taylor/Ardea London

***Harlequin Tusk fish***. *Brightly coloured to warn other fish of the same species to keep off its territory. Any invaders risk a vicious battle.*



P. Morris/Ardea London

***Seahorse***. *The male bears the children. The mother deposits the eggs in an opening located under the male's tail. The father fertilizes and incubates the eggs until he gives birth about 10 days later. He often eats a few of the 100 or more babies.*

Jon Kenfield/Bruce Coleman Ltd

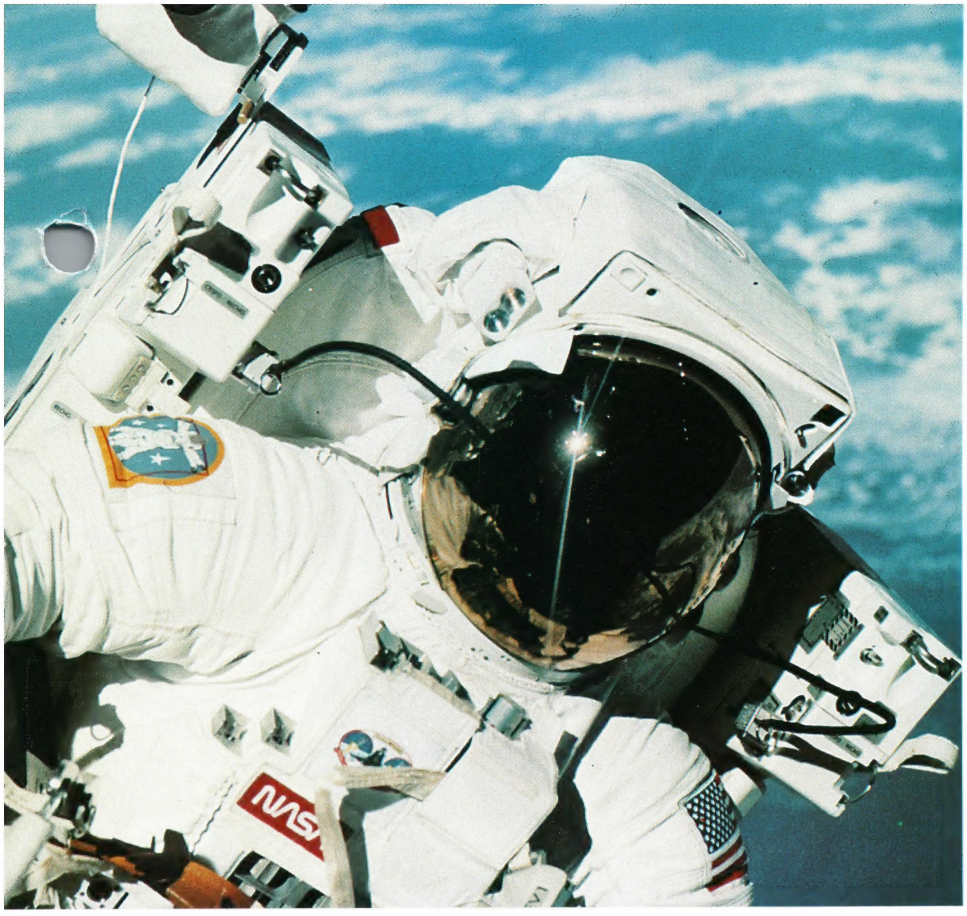
***Stonefish***. *The most venomous fish in the ocean. Lying on shallow rocks, it can be fatal to the unwary swimmer.*

Åke Lindau/Ardea London

PEP/Peter David

***Lionfish***. *Poisonous spines warn predators to steer clear. The poison is more deadly than cobra venom and causes serious injury, or death.*

***Female angler fish***. *A luminous lure on her head attracts prey into her jaws. Growing up to a metre long, the female often has parasitic males living off her blood supply.*



SPL

***Going walkabout** in space, American astronaut Bruce McCandless is encased in what is virtually a portable life support system. It protects him from harmful radiation and extremes of temperature, and also supplies vital air and air pressure.*

# SURVIVING IN SPACE

- TOUGH TRAINING
- BEATING GRAVITY
- BRITTLE BONES

**UNDER 40 YEARS OF AGE, less than 173 cm tall, excellent health, an engineering degree as well as long experience as an expert jet pilot.**

These were just some of the requirements for the USA's first astronauts. Today, the qualifications are much less strict. Even so, would-be astronauts must undergo a long and rigorous training programme.

Least popular of the devices a future space-traveller has to endure is the centrifuge. This whirls the astronaut around at an uncomfortably high speed to create the kind of stresses, known as *g*-forces, that will be experienced during lift-off and re-entry.

## Practising for zero-*g*

Once in space, the problem of high gravity is quickly replaced by that of zero-gravity, or weightlessness. Learning to cope with this strange new condition is essential if an astronaut is to carry out tasks effectively.

Since Earth's gravity cannot simply be switched off, various ways have been found to simulate weightlessness without actually going into space. One of these is for an aircraft with trainee astronauts on board to dive along a special curving path. The effect is like that in a rapidly falling lift. For about half a minute, the passengers float around inside the plane, bouncing off specially padded walls.

## Staying healthy in space

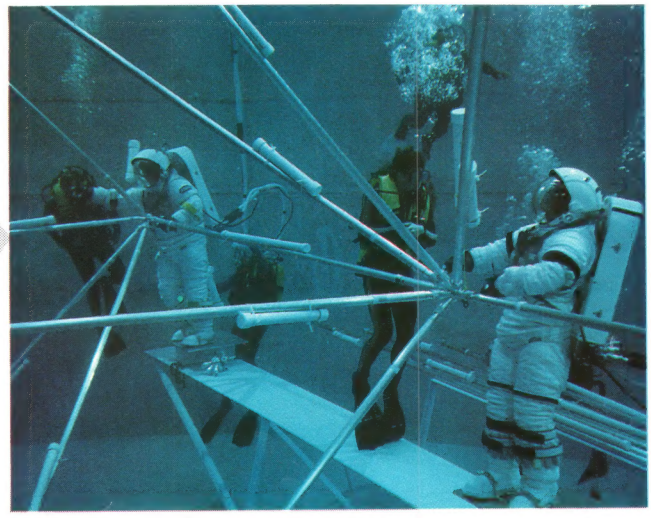
Observations on Russian and American astronauts who have spent several months in orbit have already pointed out some of the dangers of long space journeys. In zero gravity, the heart grows weaker and steadily shrinks. Muscles lose their tone and gradually waste away. But most worrying of all is the effect that weightlessness has on an astronaut's skeleton.

On Earth, our bones completely renew themselves about every six months or so. In zero gravity, however, while the calcium in an astronaut's bones disappears at the same rate as it does on Earth, new bone growth dramatically slows down. The result is that, over time, the space traveller's skeleton becomes more and more brittle. Scientists are still not sure if this defect can be completely reversed once the astronaut returns to Earth.

## On the go

One way astronauts can combat some of the problems of weightlessness is by exercising for several hours a day while they are in space. A small gymnasium, with jogging machine and exercise bike, will be essential on any future permanently manned space station or interplanetary spaceship. And it would be better still if the astronauts' living and working areas could be arranged to spin slowly around so as to provide a force similar to that of gravity.

***An astronaut** in water feels an effect similar to the weightlessness experienced in space. Wearing a spacesuit, fitted with weights so that he floats at a certain depth, he goes through the many routines he would use in space. Expert divers are on hand in case of an emergency.*



MacDonnell Douglas

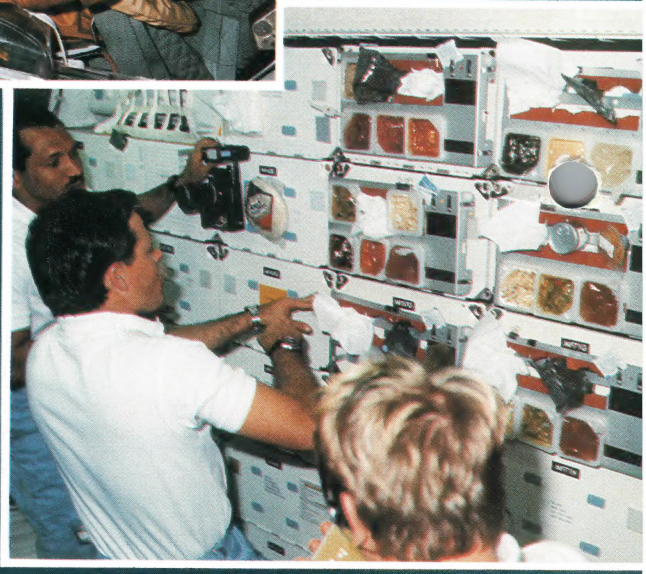
**On the inside looking out,** Kathryn Sullivan views Earth from above. Women astronauts have been on several successful missions into space.

**Before launching** into space, astronauts must go through many hours of simulated flight. Robert Crippen practises at the controls in the cabin of the Space Shuttle orbiter, Columbia, at the Kennedy Space Center. Although the system is fully automated, complete familiarity prior to launch is vital.

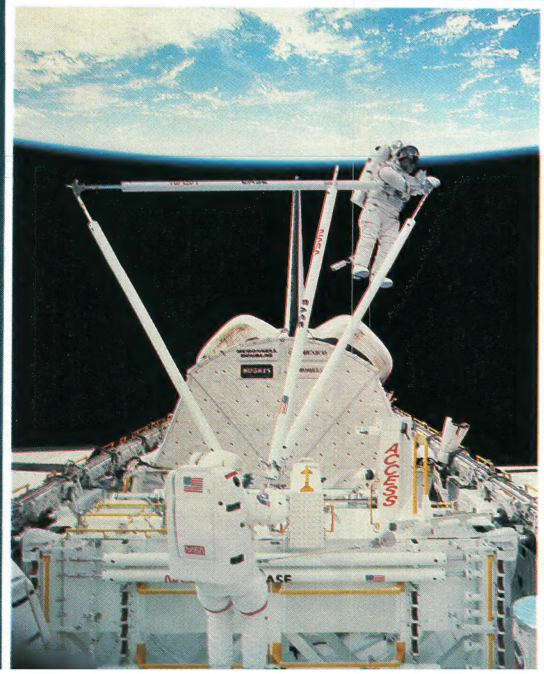
**Catch your juice.** Liquids do not pour in space but turn into globules. Drinks on board a spacecraft are sucked straight from their packs.

**Come and get it!** Steak, scrambled egg and strawberry cereal are some of the many foods taken into space. Most are freeze dried – water is added before eating. Everything is kept firmly in its place in sealed packs fixed to trays with tape to prevent them floating away.

**Tied up for a while,** two astronauts grab some sleep. As there is zero gravity in space, they have to be tethered down, and zipped into special sleeping suits to avoid floating off around the spacecraft.



**Like trapeze** artists, two astronauts rise above the payload area of the Shuttle, their feet still attached by a wire to the spacecraft. Astronauts carry out many tasks in space including maintaining and repairing the spacecraft and satellites.



**The daily grind** 226 km above Earth. Astronauts must exercise regularly while in space to combat weakening of bones caused by lack of gravity. Joe Engels works harnessed to a special treadmill located in the mid-deck of the Shuttle.

All pictures by courtesy of NASA

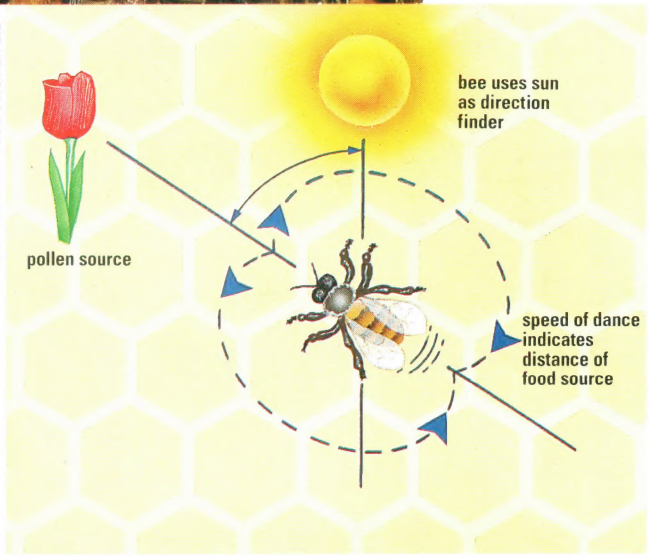
# ANIMAL CHAT

Zefa

- TALKING DOLPHINS
- TRAINING CHIMPS
- SINGING WHALES

**HUMAN BEINGS ARE NOT THE only ones who like to talk to each other. The animal world is filled with species who have their own special language.**

Mark Franklin/Bruce Coleman Ltd




***Honeybees** guide themselves by the position of the sun. The worker bees communicate the direction of a good food source by means of a dance performed in the hive.*

Honeybees, for instance, are able to communicate with one another using dance language. When a foraging worker bee has found some flowers containing nectar, it flies back to its hive and begins one of two kinds of dance. The rest of the swarm gathers around to watch the performance, which takes place on the surface of the honeycomb.

A 'round' dance by the returning bee tells the onlookers that the flowers are less than 100 metres away. A 'waggle' dance shows not only that the nectar is further afield – the slower the dance the greater the distance – but also its direction from the hive.

Animals with bigger brains, especially mammals, tend to 'talk' to one another in even more elaborate ways. The squirrel-like prairie dog, which lives on the plains of North America, has a variety of calls. Rearing up on its hind legs and pointing its nose skyward, it utters a series of two-syllable sounds to make known the territory of its own group. If some enemy approaches it can let out instead a high-pitched alarm that warns its companions to scamper underground.

***Dolphins** have been known to imitate single words of human speech, but their pronunciation is so indistinct and their delivery so rapid, that only a trained ear can understand what they are saying.*

## Almost human

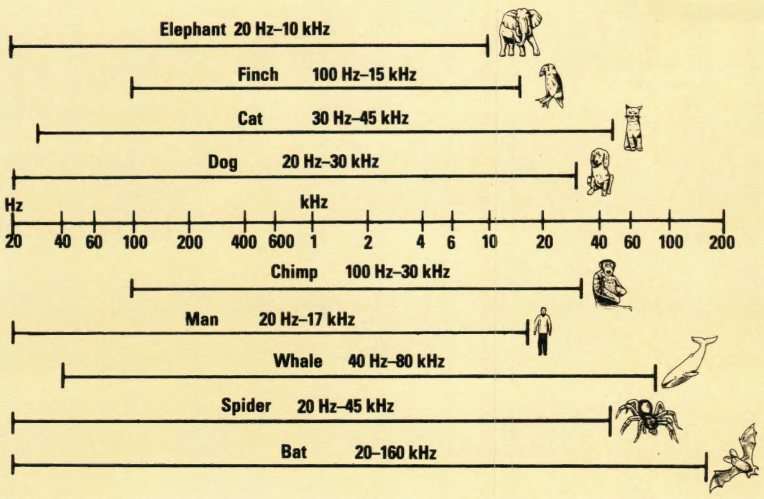
Closest of all our animal relatives are the chimpanzee and the gorilla. So, it is hardly surprising that these two African great apes should communicate in ways that often seem very human. A rich combination of sounds and gestures make up chimp and gorilla language. The big question has always been whether an ape and a person could ever carry on a conversation.

That question was answered in the late 1960s, when two American scientists hit upon an ingenious idea. Because apes are physically unable to speak like people, these scientists taught a young chimp,

***Chimpanzees** can achieve surprising powers of communication if raised by humans. One chimp learned to say 'mama', 'papa' and 'cup', and used these words correctly most of the time.*

Rex Features

## TUNING INTO ANIMAL FREQUENCIES




Hearing is a vital part of animal communication, especially over long distances. The range, which varies considerably from species to species, is measured as sound frequency or the number of vibrations each sound makes per second in hertz (Hz) or kilohertz (kHz [1,000 Hz]). Hunters like cats and dogs, tend to be tuned into the high-pitched squeaks of mice and other prey – the 'silent' dog whistle works on ultrasonic frequencies, which are far too high for us to hear. Echolocators such as bats and whales use even higher ultrasonic sounds to make long distance calls.

Just as with humans, the hearing range of many animals diminishes as the individual grows older, often putting them at risk from predators.

Mark Franklin

called Washoe, how to use deaf-and-dumb sign language. Quickly, Washoe mastered the hand signals for several dozen objects, actions and feelings.

More recently, a pygmy chimpanzee, named Kanzi, has shown an even greater understanding of human language. Most of the time, Kanzi 'talks' with his keepers at a research centre in America by punching special symbols marked on a keyboard. But the little chimp has also shown that he can understand spoken English. If asked, for instance, 'Will you go and get a nappy for your sister Mulika?', he will do it.

On one occasion, a fellow chimp of Kanzi's, called Austin, was moved into another compound. For a while Kanzi seemed to miss his usual bedtime visit with his friend. But after several lonely nights he solved the problem by typing the symbols 'Austin' and 'TV' on his keyboard. When a videotape of Austin was played, Kanzi settled happily into his nest for the night.

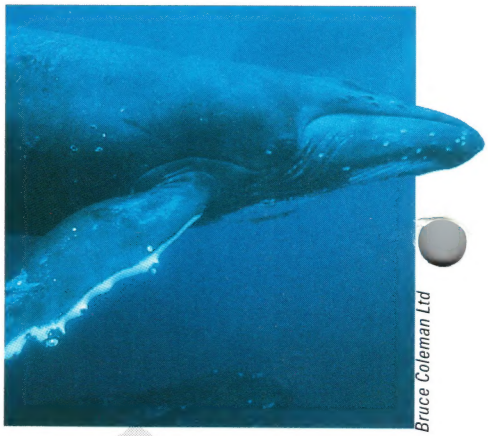
Dolphins and whales may not look much like people, but their large brains and complex patterns of behaviour suggest that they are very intelligent creatures. They also seem to have a sophisticated language for communicating with each other, made up of clicks, whistles and strangely beautiful songs.

### Songs of the sea

One of the great unsolved mysteries of the natural world concerns the songs of the humpback whale. At the start of each breeding season, all the male humpbacks sing the same complicated song that may go on for half an hour at a stretch. The sounds are so loud they can be heard underwater as far as 5 km away! Gradually, as the breeding season progresses, the song of all the humpbacks changes. By the end of the season, the song has become completely different.

When breeding time comes around again, the male humpbacks congregate once more and go through the whole process again.

No one knows why the humpbacks sing – or why their song changes each year. Using recording apparatus and computers, scientists have analyzed the amazing variety of sounds that whales and dolphins make. They hope, one day, to decipher some of the language of these creatures and try to communicate with them.



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***Courting humpbacks*** *communicate by exchanging playful blows. Though meant to be tender, the blows can be heard for miles.*

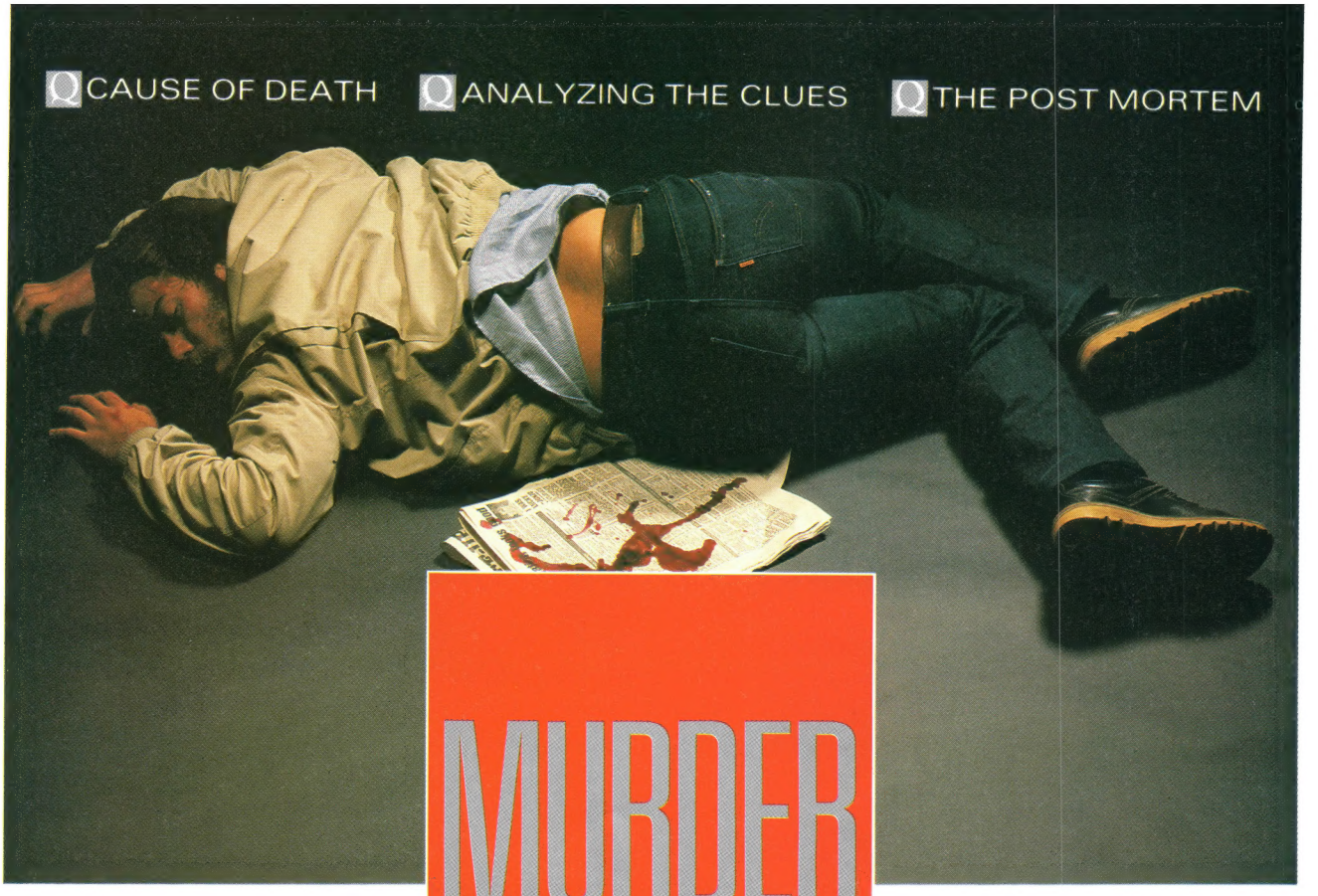
## CHEMICAL MESSAGES

Partridge Productions Ltd/OSF

Chemical substances called pheromones, secreted by the ants, are the prime means of communication within the colony. Worker ants tending the queen constantly lick her and gather together the pheromones she produces. The workers quickly circulate these to the other ants. Soldier ants also produce pheromones, and when the number of soldiers in the colony falls the queen – aware of the drop in the amount of soldier pheromones – produces special eggs destined to be soldiers.


Paul Raymonde

CAUSE OF DEATH ANALYZING THE CLUES THE POST MORTEM



# MURDER ONE

## ESTABLISHING THE CAUSE OF DEATH

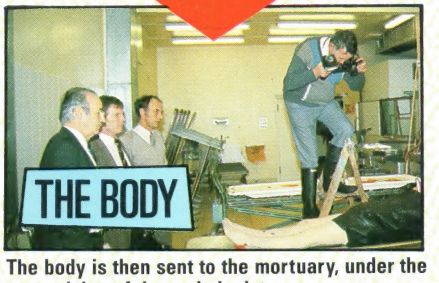
**DR. HAWLEY HARVEY CRIPPEN, the notorious wife killer, mass poisoner Graham Young, John Haigh, who immersed his victims' bodies in baths of acid – these and many other murderers were unmasked by the police department's team of medical scientists.**

Pathologists, toxicologists and dentists join together to find conclusive evidence from a single hair, a few fibres of cloth, a speck of dust or even teethmarks in an apple.

Once a body has been discovered the police are immediately faced with several questions – what is the victim's name and background? What could have caused the wound? Did it cause the victim's death? At what time did the victim die? Was the victim's death an accident, suicide or murder?

When the police have checked the scene of the crime for clues, it is up to medical science to examine the evidence and provide the police with the vital clues that may lead to

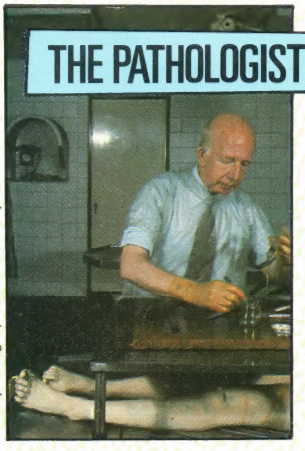
**At the scene of the crime, a pathologist examines the body for wounds and bruising. The body temperature is taken to estimate time of death.**



### THE BODY

**The body is then sent to the mortuary, under the supervision of the pathologist.**

### THE PATHOLOGIST



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**The post-mortem is conducted at the mortuary, by a pathologist of their choice.**

### THE POST-MORTEM

**The findings of the pathologist are relayed to the coroner who then arranges for an inquest.**

**The police inform a police surgeon and the criminal investigation unit of the coroner's office, who then inform the coroner.**

### THE CORONER

**The coroner, in consultation with a senior police officer, arranges for a post-mortem to be carried out.**

### THE INQUEST

**The findings of the inquest may lead to criminal proceedings, after which the body is released for disposal.**

## WHEN DID HE DIE?

**Monday – midnight**
12:00 1
Muscles relax immediately and brain starts to liquefy.

**Tuesday – am**
12:10 1
Eyes begin to cloud over not long afterwards.

**Tuesday – am**
5:00 1
Skin begins to discolour due to draining of blood.

**Tuesday – am**
6:00 1
Rigor mortis (the stiffening of muscle) begins in the face.

**Tuesday – noon**
12:00 1
Rigor mortis complete. Body temperature now down to about 25°C.

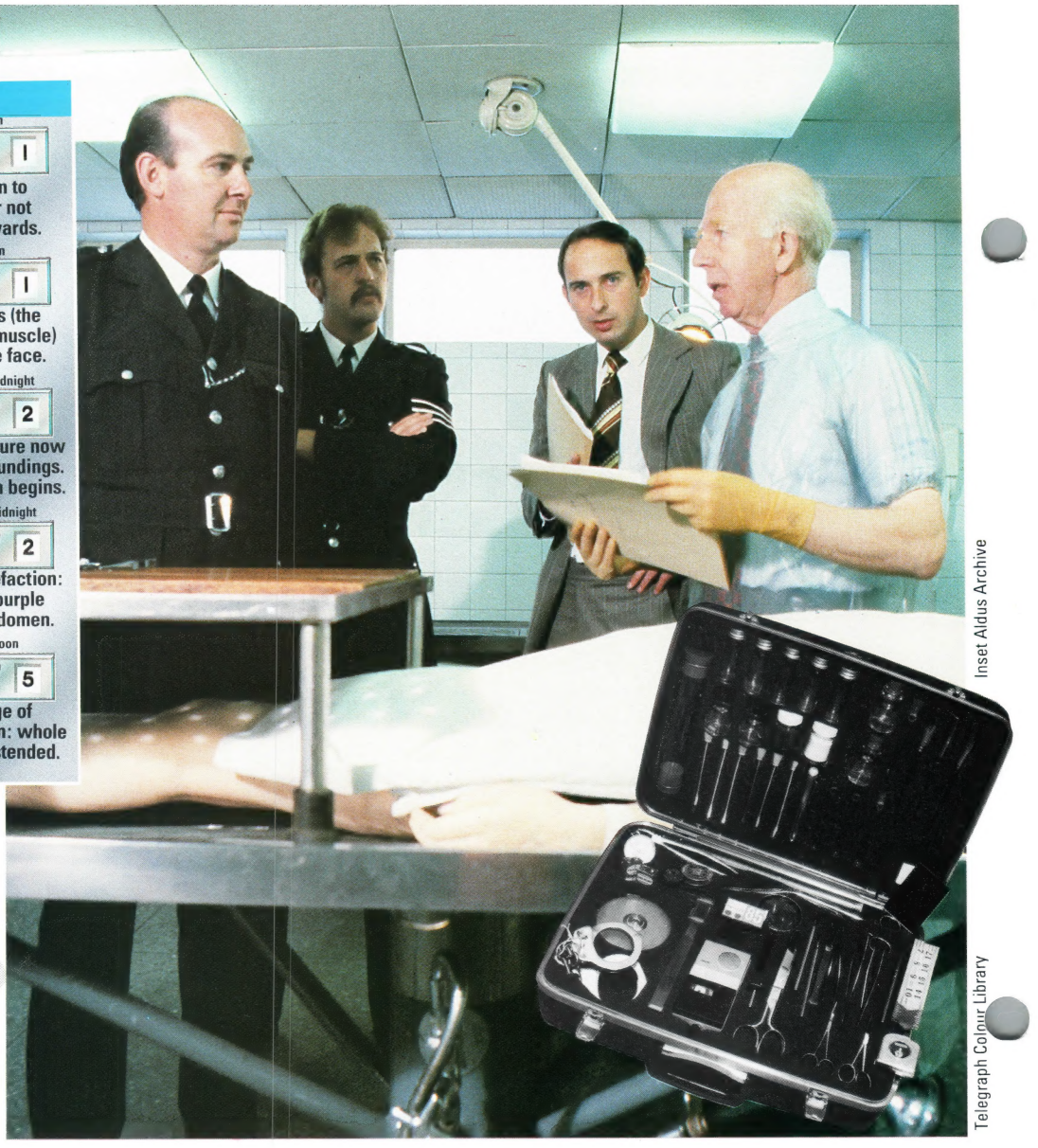
**Tuesday – midnight**
12:00 2
Body temperature now same as surroundings. Decomposition begins.

**Wednesday – noon**
12:00 2
Rigor mortis has now disappeared altogether due to decomposition.

**Wednesday – midnight**
12:00 2
Signs of putrefaction: green and purple stains on abdomen.

**Thursday – noon**
12:00 3
The next stage of putrefaction: marbling of veins due to gases.

**Saturday – noon**
12:00 5
Later stage of decomposition: whole body now distended.



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***The pathologist*** *must heed external factors when pinpointing the time of death. A naked body exposed to cold weather loses heat quicker than a clothed one found in a warm house. A corpse submerged in water loses heat twice as fast as one found on dry land. And decomposition occurs quicker in a warm, wet atmosphere.*

the capture of victim's attackers.

After an initial examination, the body is taken to the mortuary, where it is stored at low temperature to preserve any evidence. The police inform the coroner, a government official charged with investigating sudden death, who arranges for a pathologist to hold a post-mortem (Latin for 'after death') examination of the body. Once the victim has been identified by a relative or police officer, the post-mortem can begin.

Topham

***Samples of shot*** *are removed from a shotgun wound and sent to the forensic science laboratory for examination. The pathologist then tries to gauge the range and direction of the fatal shot. A rough guide in judging distance is that the spread of pellets in inches equals the range in metres. A circular pattern indicates a discharge at right angles to the body, an elliptical wound indicates the shot came from the side. Knife wounds on the hand (inset) are evidence of an attempt to fend off or grab the murder weapon.*

The pathologist first examines each article of clothing worn by the victim, looking out for any clues to violent death. Cuts or tears in the garments could reveal knife or bullet holes; fibres or hair could give a clue to the assailant; and traces of earth or dust might indicate a struggle or that the body had been dragged some distance.

Samples of the victim's own hair are taken, so that it can later be distinguished from any hairs left by the murderer. Other samples taken might include scrapings from beneath the victim's fingernails. All details are noted down by the pathologist and the samples put into polythene bags, labelled, and sent to a forensic science laboratory for analysis. In London, the Metropolitan Police Forensic Science Laboratory carries out over 30,000 investigations each year.

## Marks of murder

The pathologist next weighs the body, and then begins a painstaking examination for wounds, bruises or scratches that might reveal the cause of death, or give a clue to the murder weapon or even the killer.

A pathologist can tell from the

shape of a knife wound whether a single or double-edged weapon was used. Additional scratches show that the victim could have put up a fight. If there are no scratches, the victim may well have been caught by surprise.

If the pathologist finds gunshot wounds, he will have the body x-rayed. The x-rays should reveal the location of the bullet as well as the path of entry.

On occasions, knife and bullet wounds can look similar, and the pathologist might have to use a scanning electron micrograph – a highly sophisticated microscope – to show up the smear of metal left by the bullet.

He then turns his attention to the inside of the body in his search for clues as to cause of death, taking samples of tissue, blood and other bodily fluids for analysis. These are carefully stored and labelled. In the past, some murder trials have failed because samples from different bodies could have been confused, as happened during the trial of Marie Bresnard, the 'Black Widow of London', in France.

## The poison detector

If the pathologist is still unsure exactly how the victim died, he calls in the toxicologist, who specializes in detecting poisons, harmful chemicals and bacteria in the body. The toxicologist has a range of sophisticated techniques at his disposal for the analysis of specimens from the 'path lab'. These include:

- **EMIT (Enzyme Multiplied Immunoassay Technique):** an automated testing device that detects the presence of most kinds of drugs in the bloodstream.
- **Thin Layer Chromatography:** a method of chemical analysis that detects 90 per cent of known poisons. Various chemical components show up as different coloured streaks on absorbent paper, reflecting differing chemical structures.
- **Mass Spectrometry:** specimens of blood are vaporized, electrically charged and driven through a magnetic field. The components in the blood samples are deflected by differing amounts by the magnet. These deflections can be recorded on a photographic plate and the chemicals identified from their different spectral patterns. Once the toxicologist has completed his tests, the pathologist puts the body back into storage and writes a report for the coroner on the likely cause of death.



Topham

***Potential clues** such as hair or blood stains found on a victim or at the scene of a crime (inset below) are examined at the forensic laboratory. Bloodstained areas on a murder weapon can reveal a clear fingerprint of the attacker (inset above).*

## Contact traces

Having discovered how the victim was killed, the pathologist starts to examine the samples he took earlier from the victim's clothes and body, to help find the killer.

When the Yorkshire Ripper murdered his ninth victim, Josephine Whitaker, pathologists found minute quantities of engine oil on her body, probably from her killer's fingernails. The Ripper, Peter Sutcliffe, was a lorry driver. This case illustrates a basic principle of criminology – stated by Frenchman, Edmond Locard in 1910 – every contact leaves a trace. When one person attacks another, something of the attacker will be left on the victim's body or vice versa.

A single hair recovered from the victim's clothes and examined under a microscope can tell the police much about the assailant. Infallible proof that the hair came from the murderer can be obtained by 'neutron activation analysis' – placing the hair and a sample of hair from the suspect in a nuclear reactor, bombarding them with neutrons and comparing their chemical make-up.

A murderer may also leave telltale fibres from his clothing on the victim that are detectable under a microscope. After a full analysis, the scientist can form a clear idea of what the murderer was wearing from just a few fibres. Leslie Stone, the Railways killer, was caught because a thread from his victim's clothes was found on his suit.

Similarly, the smallest glass or paint fragments can be detected on clothing. If hair, fibres, paint or glass fragments link a murderer and his victim, it could send him to jail for life.

### DEADLY POISONS

**Arsenic:** Slow acting, tasteless and odourless. Remains in the body after death, particularly the hair. Readily detected by chemical analysis or gas chromatography.
**Cyanide:** Very fast acting. Can be detected immediately after death by bitter almond smell and pink patches on the skin. Traces persist, particularly in the spleen.
**Strychnine:** Quick acting, but has sharp bitter taste. Not always detectable.

**John George Haig,** known as the Vampire Killer, killed six people and immersed their bodies in a bath of acid. He came unstuck when the dentures of his last victim were found undamaged.


Topham

**Graham Young,** a compulsive poisoner, poisoned his father, sister and a friend in 1962. After his release, he went on to kill another two people ten years later. Over 70 workmates became victims of his poison obsession.


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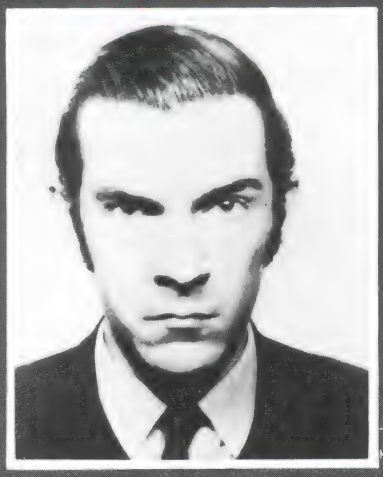

Topham

**Peter William Sutcliffe** terrorized the women of Yorkshire for a period of five years, between July 1975 and November 1980. In that time, he murdered a total of 13 women and attempted to murder another seven. He was caught by a sharp-eyed PC who checked out his car number plates and found them to be false. He was sentenced to 30 years minimum.


Topham

**Dennis Andrew Nilsen** was found guilty of six murders and two attempted murders at his trial in 1983. After human flesh was discovered in the drains of the house where he lived, he confessed to a total of 15 murders. All were young men whom he had befriended and invited home with him. Only one of his victims was ever reported missing.


Associated Press


Topham

**John Reginald Christie** confessed to six murders at his trial in 1953. He was also thought to have killed a further two victims – Beryl Evans and her daughter Geraldine. Christie's crimes came to light after he moved home and the next tenant discovered some bodies in a hidden cupboard. A police search revealed even more bodies.


Associated Press

**Theodore Bundy** received three death sentences at different trials. He was convicted when bite marks on one of his victims matched his teeth.

**Wayne Williams,** found guilty of two murders, but may have committed 28. Found near the scene of his last murder, fibres in his car matched the victim's clothing.

# HIJACK!

TERRORISTS SPECIAL UNITS HOSTAGES


Gamma/Frank Spooner Pictures

***The Kuwait Airways** hijack ended in Algiers, when the terrorists fled without warning. Balaclava'd gunmen seized control of the cockpit during the hijack of a TWA jet in Beirut in 1985 (inset).*

**DAWN ON 5 APRIL 1988, AND for the 97 passengers and 15 crew aboard Kuwait Airways flight 422, a nightmare has just come true. A scheduled flight from Bangkok to Kuwait has been hijacked by a gang of Islamic terrorists.**

In such a situation, negotiations are always the first option for the authorities. Storming the plane – although highly publicized – is the last resort to end a confrontation.

As soon as a hijack takes place, a huge international machine swings into action. Criminologists, psychologists, army commanders, police officers and academics all assess each area of the situation and try to come up with a plan by which, ideally, all the hostages would be released unharmed, and all the hijackers would be disarmed and taken into custody.

## A waiting game

Highly sophisticated techniques of psychological assessment are now used when a hijack is in progress. The most important weapon of the counter-terrorist official is not a submachine gun or a stun grenade, but time. As the minutes turn into hours, and the hours into days, a fresh, fit terrorist becomes dirty, tense and tired – demands turn into requests, deals turn into trade-offs, hostages become companions.

While the authorities can work in shifts, the hijackers have to remain alert 24 hours a day – ready, if necessary, to start shooting. A week of this constant pressure can weaken the resolve of the most hardened fanatic.

However, the longer a hijack continues, the greater the problems become. When a hijack is in progress, temperatures inside a stationary aircraft, particularly in the Middle East, can rise to a humid 45°C. This debilitating heat, combined with the constant fear of death, and the huge quantities of adrenalin produced by the body, can cause severe illnesses.

Hyper-tension often results, putting great stress on the heart. Acute claustrophobia, fatigue and insomnia are all common side-effects. Freed hostages can suffer from psychological problems for months after their ordeal. An extra complication arises when a hostage begins to sympathize with the terrorists – a condition known as the Stockholm Syndrome.

## Bargaining ploys

The counter-terrorist authorities can use time to their benefit by slowly chipping away at the terrorists' main demand – the release of prisoners, payment of a large ransom, and so on. They make contact by radio, and give the hijackers everything they want to survive, such as food, water and medicines. By treating them well, they hope that the hijackers will slowly wear down and feel less desire to challenge authority and make difficult demands. If they refuse to compromise, however, the officials might cut

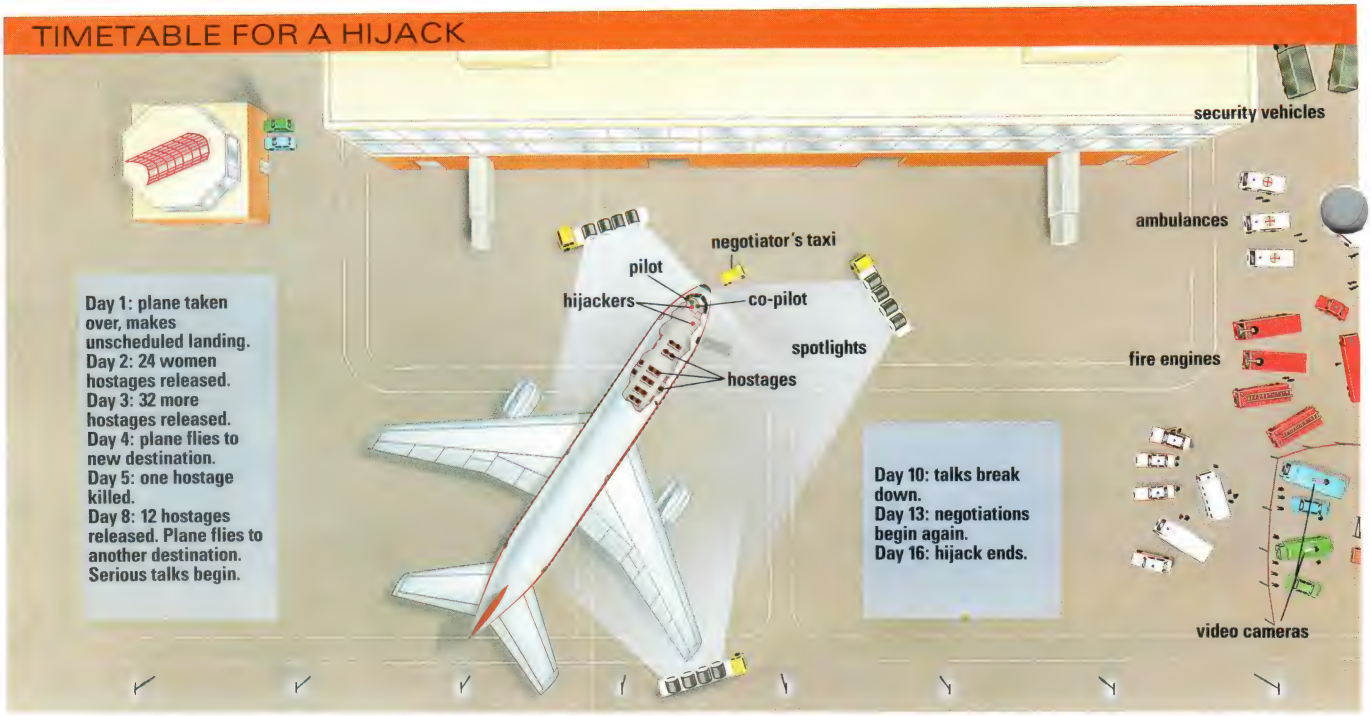
## Just amazing!

### HIJACK HOWLER

*ON A FLIGHT ACROSS THE USA IN 1976, A PASSENGER SUDDENLY STOOD UP, POINTED A GUN AT A STEWARDESS AND DEMANDED TO BE FLOWN TO DETROIT. WHEN SHE TOLD HIM THEY WERE GOING TO DETROIT ANYWAY, ALL HE COULD DO WAS SIT DOWN AGAIN.*

Paul Raymonde

## TIMETABLE FOR A HIJACK




Mark Franklin

off their food and water supplies. So, the longer a hijack continues, the less control the terrorists have over their own fate.

But there are also problems with extended negotiations. Lengthy delays in meeting hijackers' demands can lead to violence – as occurred in the Kuwait Airways hijack, when two passengers were killed.

### Special forces

The major concern of all the officials on the ground, though, is the safety of the hostages. This is why armed intervention is avoided whenever possible – the risk of hitting a passenger is too high. Most countries do, however, have their own counter-terrorist force on standby in case of a hijack. In Britain, this unit is called the Special Air Service, or SAS.

## STOCKHOLM SYNDROME

When a TWA jet was hijacked to Beirut in 1985, many of the hostages began to show signs of a condition known as the Stockholm Syndrome. Named after a bank hold-up in Sweden, the Syndrome results in close emotional bonds being formed between hostage and captor.

In the TWA hijack, for instance, the pilot, John Testrake, defended the gunmen, saying they had a 'just grievance'. This kind of attachment by victims to terrorists when under extreme stress and in mortal danger is well recognized by psychologists. But it adds a dangerous new facet to the negotiations.

If the hijacker forms a close relationship with a hostage, the hostage stops being a bargaining tool and becomes a human being – and more difficult to shoot. Should a chance to escape appear, the hostage may also think twice, about putting himself, and his rescuers, in danger.

Rex Features

***A civilian hostage*** *escapes from the burning Iranian Embassy in London, moments after the SAS stormed the building. Out of sight, a marksman from Scotland Yard's crack C11 unit keeps him covered*

The SAS operate as an extension of the police resources, but they are, in fact, a regiment in the British Army. When they are called to a hijack, they design intricate plans for successful stormings of the plane, should it be necessary. They have maps of the airport buildings, plans of the aircraft itself, and detailed dossiers on the terrorists themselves. If any hostages are released by the hijackers, they are closely questioned about the behaviour of the terrorists, and their moods and feelings.

The SAS had their most violent brush with terrorists when they relieved the siege of the Iranian Embassy in London, by Arab separatists, in May 1980. But the SAS has such a high reputation for efficiency and smoothness of operation, that they are often called out to attend hijacks in various parts of the world. One of their biggest operations was in 1977, when, with the help of the German equivalent of the SAS – a unit called GSG9 – they successfully stormed a plane hijacked to Somalia, and freed all 79 hostages unharmed.

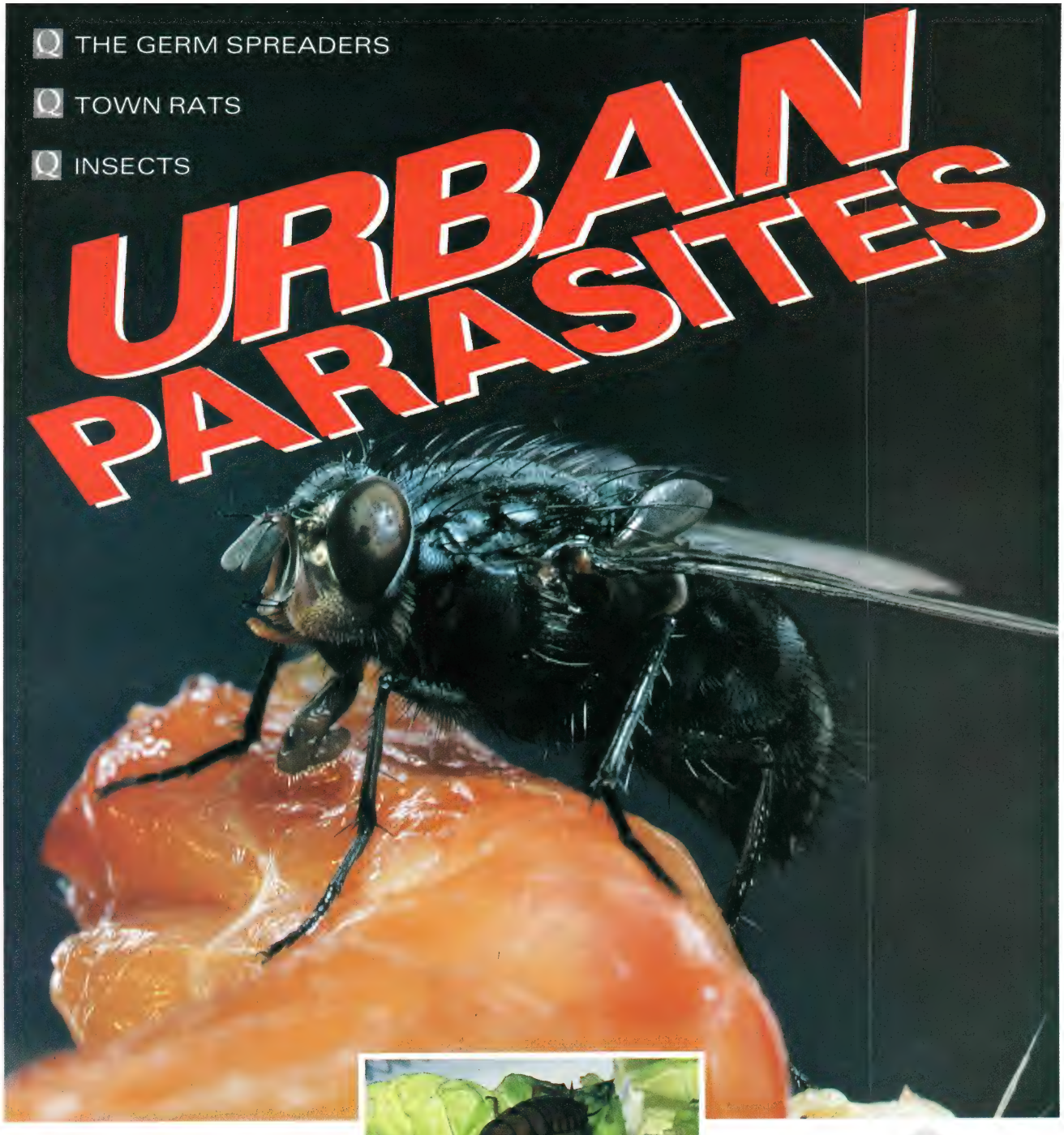
### Undercover unit

There is a second British counter-terrorist force called SO10, attached to Scotland Yard. This unit was called to the Kuwait Airways hijack to give information and advice on undercover surveillance techniques.

One of the techniques this unit might recommend is flooding the aircraft with invisible infra-red light. By using special cameras that respond to infra-red, they could then see exactly what was happening in the plane, day or night. Inside, the hijackers would be completely unaware of what was going on.

- THE GERM SPREADERS
- TOWN RATS
- INSECTS

# URBAN PARASITES



Kim Taylor/Bruce Coleman

Papilio

***Bluebottles*** *prefer to lay their eggs on dead flesh. When the eggs hatch, the maggots burrow into the meat. The body of a rat can feed about 4,000 maggots before they emerge as flies.*

***Cockroaches*** *eat a wide range of food including dead animals and kitchen waste. They destroy foodstuffs, partly by gnawing them, but also by fouling them with their unpleasant smell.*

**IN EVERY CITY, THERE ARE millions of creatures – most of which lurk in walls, sewers or under floorboards. Some, such as houseflies, we see every day, others, such as rats, are silent hunters of the night.**

The common housefly is potentially the most dangerous insect in the world. It can transmit 30 diseases and parasitic worms via vomit drops – partially digested food and saliva which is regurgitated on to its next meal to prepare it for eating.

The housefly rarely strays more than a kilometre from its place of birth. Most of its life will be spent moving between food and filth. It breeds on rotting organic matter, including excrement on which it will also feed before flying off to find a bowl of sugar on which to land. The common housefly has a sense of taste that is ten million times more sensitive than that of a human being.

There are approximately 3,500 species of cockroach and the vast majority are tropical. In the last 200 years, they have been introduced to the cooler European climate where most are dependent on heated buildings to survive. Cockroaches are nocturnal creatures. At night, they crawl out of their warm homes – often inside the television set – to scavenge for food. By morning, they disappear without trace.

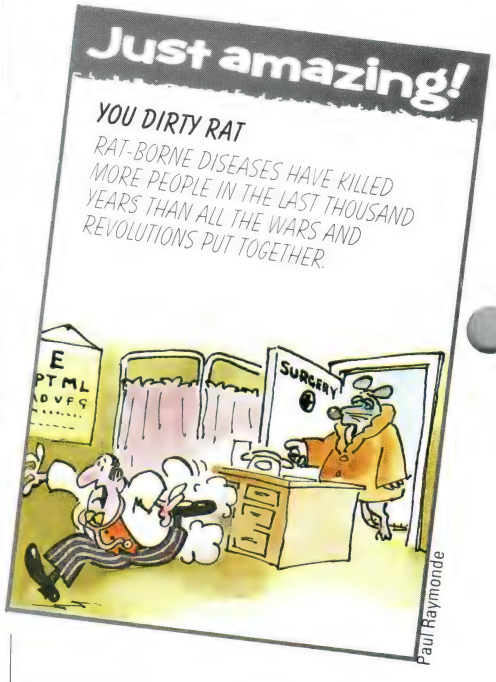
Each year, a hundred people in England and Wales catch Weil's disease. The symptoms are fever, jaundice, a swollen liver and internal bleeding, leading eventually to a slow painful death. The virus is carried in rat's urine and is transmitted to Man through cuts and grazes

Richard Vaughan/Ardea

Rentokil

***The curved incisor teeth*** *of rats require continual wearing down by gnawing anything which is hard wearing. For this reason, water pipes and electrical wiring are frequently attacked by rats, causing flood and fire hazards.*

***Rats are scavengers*** *– they will eat almost anything they can find. They have been known to steal live ducklings from city parks and several elephants in Hamburg zoo have had parts of their feet eaten by rats.*




Paul Raymonde

in the skin. Contact with contaminated water from canals or sewers is the usual means by which the disease is spread.

## Rat's highway

The 17,000 km of sewer under London make an excellent home for the brown or sewer rat. Each kilometre can support about 500 rats, and the warm humid conditions are perfect breeding grounds. A pair of rats and their offspring produce about 1000 babies a year.

Another rodent which is found wherever Man has set up home is the house mouse. Mice live inside buildings, often in walls. From here, they will gnaw their way into the kitchen. They shed 80 droppings every day and urinate constantly to mark their territory.

In the nineteenth century, sparrows were introduced to New York from Britain to keep the number of insects down. Now, they are common inhabitants of all US cities and are considered pests – they are often referred to as 'flying mice'.

Another European bird which was introduced to America is the starling. These birds flock to cities at night to take advantage of the higher temperatures usually found in cities. Each flock can number up to half a million birds.

## City wildlife

Pigeons have adapted well to urban life. They will rummage for food among rubbish tips and dustbins. They can carry and spread a number of diseases and fleas. Bird fanciers lung can be caught by inhaling dry pigeon droppings.

As cities grow in size and number, increasingly more animals make their homes in them. Even birds of prey, such as kestrels and peregrine falcons, are attracted to cities with their rich food supply – plenty of small birds and rodents.

***Millions of starlings*** *migrate to British cities from Central Europe every winter. They are messy birds – a starling can shed half its own body weight in droppings every day.*

## THE DISEASE CARRIERS

| PEST | DISEASES CARRIED |
|---|---|
| RODENTS | |
| rats | Weil's disease, rabies, bubonic plague, typhus, salmonella |
| mice | Typhus, spotted fever, salmonella |
| BIRDS | |
| pigeons, starlings, sparrows | Typhus, tapeworm, ornithosis, salmonella, encephalitis, histoplasmosis |
| INSECTS | |
| cockroaches | Salmonella, threadworm, dysentry, jaundice, gastroenteritis, boils, pneumonia |
| houseflies, bluebottles | Dysentry, anthrax, cholera, gangrene, salmonella, tapeworm, boils and abscesses, threadworm |

ANIMAL SOCIETIES HUNTING TOGETHER SOCIAL BEHAVIOUR

Ardea

# ANIMAL KINGDOMS

***Animals form families*** *readily even if temporarily. A new male lion in a pride will kill cubs not fathered by him to make way for his own offspring.*

***Zebras band together*** *in their hundreds. Their stripes set up a dazzling pattern, which makes individual animals hard to distinguish and hence less vulnerable to predators.*

**ALONE, AN ARMY ANT WILL quickly die. But as part of an enormous swarm it is one of the most successful – and deadly – creatures in the world. Nothing can survive in the path of army ants when they are raiding for food.**

Other types of animal, too, habitually live in groups for one reason or another. Both wolves and hyenas, for instance, hunt in packs. As a group they can bring down a beast much too big and strong for any individual to tackle. And their prey, such as zebra and wildebeest, also move together in large herds to make themselves less vulnerable to attack.

Sometimes, a normally solitary animal will join others of its kind for a special event like mating. In other cases, two creatures of quite different species will live permanently together, each benefitting from their close relationship.

## Farmer ants

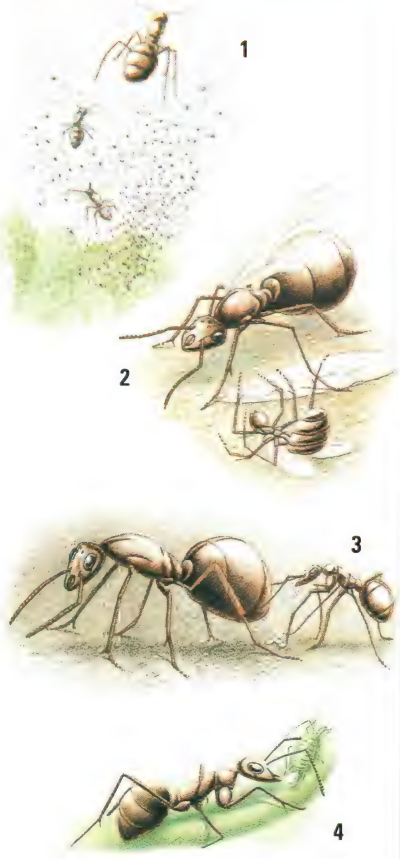
Ants may be helpless by themselves, but in colonies of thousands or even millions, they are capable of the most astonishing feats.

Bruce Coleman Ltd

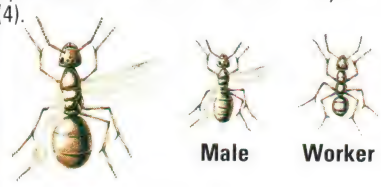
Gerald Cubitt/Bruce Coleman Ltd

***Elephants roam*** *in herds, but the sexes stay separated. Female elephants form strong bonds in groups headed by matriarchs, while bull elephants tend to form looser connections.*

J. Allan Cash Ltd.




Black garden ants live in colonies populated by males and workers, and dominated by a queen. Each has a specific role. In summer, the males mate with virgin queens from other colonies, while the workers scurry around (1). The male dies after fertilizing the queen, who then breaks off her wings (2) and starts a new nest. There, she lays the eggs, which are carried by the workers to a warm place (3). Workers also bring food. They tickle aphids to make them excrete honeydew (4).

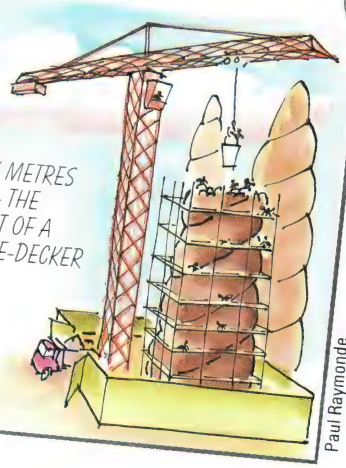



Mark Illey

## Just amazing!

**TERMITE TOWERS**

COLONIES OF TERMITES BUILD SPIRAL MUD TOWERS UP TO SIX METRES TALL – THE HEIGHT OF A DOUBLE-DECKER BUS



Paul Raymonde

Like miniature farmers, some ants tend herds of aphids (such as greenfly), letting them graze on plant sap during the day and returning them to be 'milked' in the nest at night. When stroked by their keepers, the aphids give off drops of a sugary liquid made from the plant sap which the ants then drink.

Another kind of ant, the leaf-cutter, farms in a different way. The workers slice off pieces of leaves with their sharp jaws and then carry these back to their underground homes. There they chew the leaves until soft, spread them out and use them as fertilizer to grow a unique type of fungus that is the colony's staple diet.

## Ant raiders

The so-called Amazon ants invade the nests of other ants, spraying a chemical into the faces of any defenders to confuse them. Then the Amazons kidnap the eggs and larvae in the nest and take them back to their own home. When the stolen young mature, they become the Amazons' slaves, digging, building, and even helping to carry out future raids for their captors.

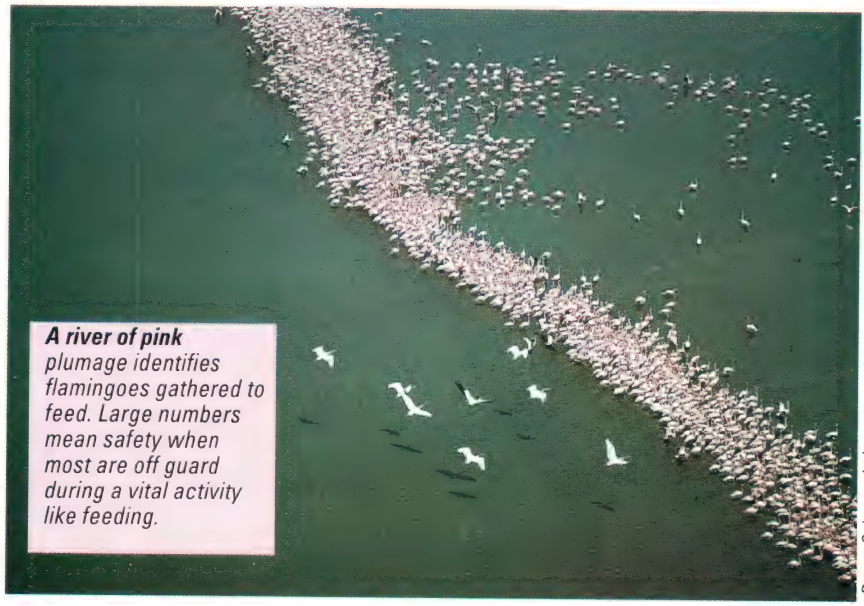
No ant society, though, is as extraordinary as that of the army ants of South America. Instead of constructing an ordinary nest, a colony of army ants joins up to make a living 'bivouac' in a hollow tree or other sheltered place. The millions of ants in the swarm hook their legs together to form a seething mass, with the queen and her young protected deep inside. During periodic raids, huge numbers of army ants march across the forest floor like a brown river, overwhelming everything in their path.

## Hunters and hunted

In packs with up to two or three dozen members, wolves can successfully ambush animals as big as a moose or an elk, harrassing and tiring their victim before finally dragging it down. On the plains of Africa, roving bands of hyenas and hunting dogs work in a similar way. Having first separated an animal from its herd, they jump on it and, by sheer weight of numbers, bring it to the ground. Then the rest of the pack – the young and their mothers – join the hunters to devour the kill.

To afford some protection against such strikes, the hunted animals themselves live and graze together in large groups. Zebra, antelope, wildebeest and other targets for the hunters of the plains wander about in herds numbering many thousands. For the same reason, fish often swim in shoals, confusing an attacker, such as a shark, by swimming together in a zig-zag path.

Sometimes, though, the strategy of certain fish to remain in shoals can backfire. Groups of pelicans sometimes form a line across the water, beating the surface with



***A river of pink*** *plumage identifies flamingoes gathered to feed. Large numbers mean safety when most are off guard during a vital activity like feeding.*

Bruce Coleman Ltd

their wings to drive shoals of small fish into shallower water where they can be easily scooped up. Meanwhile, danger beneath the waves comes from the toothed whales which, attracted by great gatherings of fish, band together in schools themselves to improve their chances of a sizeable catch.

## One for all, all for one

It can be very hard to tell with some creatures where an individual ends and a colony begins. Corals, for instance, are made up of enormous colonies of tiny animals called polyps. As a polyp grows, it forms a hard, chalky cup around itself and feeds by trapping even smaller creatures in its tentacles. Eventually, a lump sprouts from its side and develops into a new polyp. In time, this 'daughter' polyp also gives rise to its own offspring, and so the process repeats itself over and over again, until a vast city of corals is built up forming a tropical reef.

Strange as it may seem, the deadly Portuguese man-o'-war, with its long stinging tentacles, also consists of a polyp colony. The big gas-filled float of this jellyfish is really a single polyp that has become highly specialized. Three other polyps hang in a tangled mass below the surface. Three kinds of polyp are concerned with catching prey, feeding and reproduction.

The most advanced of animal societies are those in which all members of a group care and work for one another. Elephants have an especially strong communal spirit, so that if one elephant is hurt, the others in the group will go to its aid and try to help it recover. They may bring leaves, berries and branches until it is well again.

Like human children, young elephants learn by spending years with their mother and with the rest of the herd. An old female – the matriarch – is always the herd's leader, having acquired the most knowledge of trails and the whereabouts of food and water.

Even more advanced is the social life of monkeys and apes. Although some monkeys do live in small family units, most dwell in larger groups led by several adult males.

During the first few weeks of their life, baby baboons are black and, hence, very noticeable. Attracted to the new animals, other members of the troop continually try to touch and caress them so that the infants quickly learn to recognize all of their neighbours.

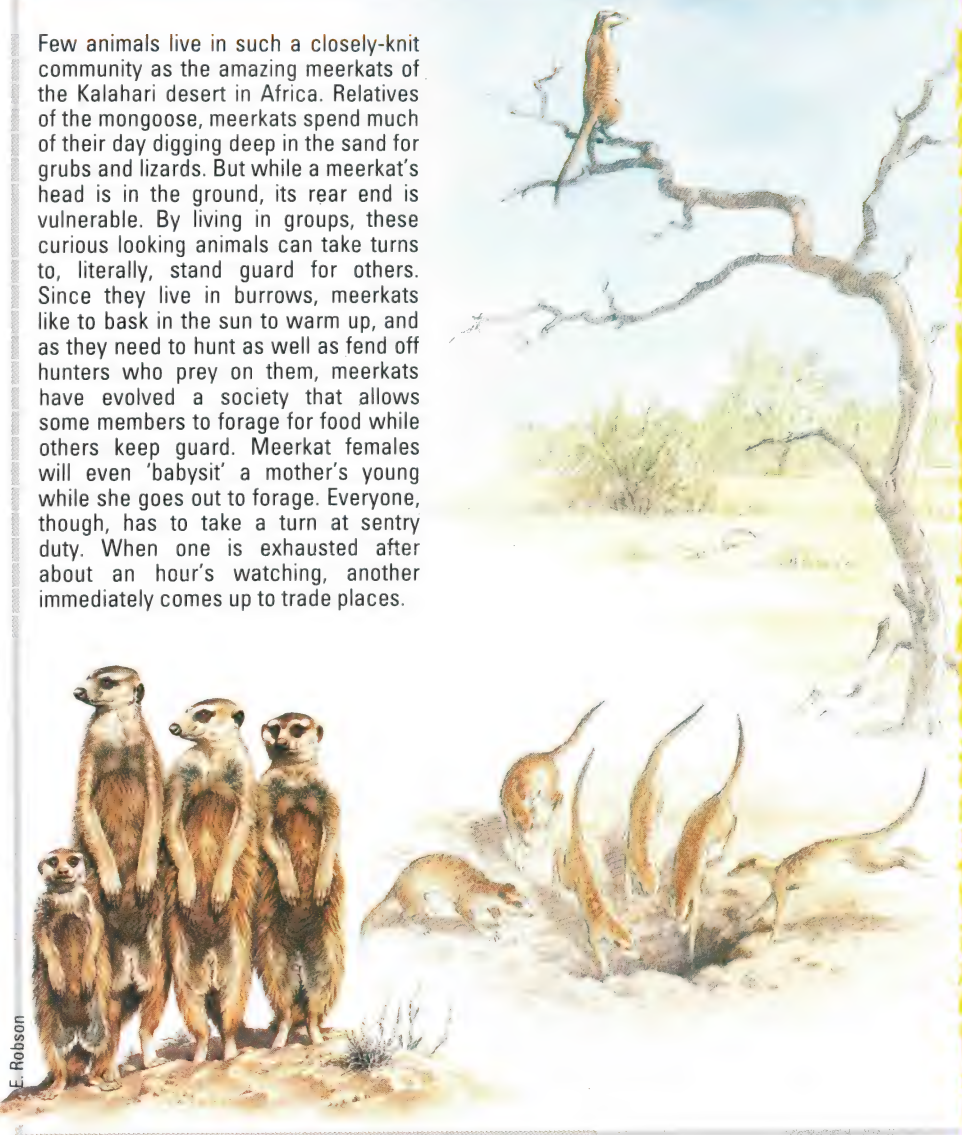
## Clever chimps

Because it is perhaps the cleverest and most adaptable of apes, the chimpanzee has an exceptionally rich social life. Young chimps must spend ten years or more watching, playing and learning from their fellows before they can properly fend for themselves.

Like people, chimps have a variety of sounds and facial gestures by which they can communicate with one another. They use natural weapons and tools to defend themselves and to poke tasty termites out of their mounds. The young chimps must learn all these skills within the safety of their group.

## A UNITED FRONT

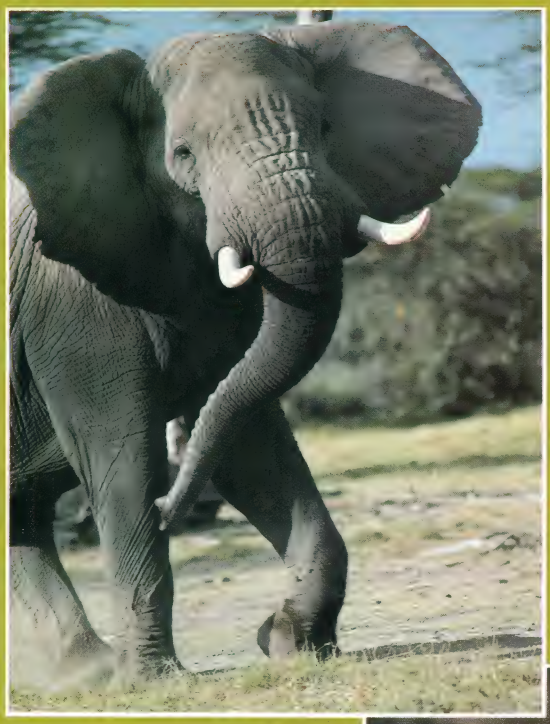
Few animals live in such a closely-knit community as the amazing meerkats of the Kalahari desert in Africa. Relatives of the mongoose, meerkats spend much of their day digging deep in the sand for grubs and lizards. But while a meerkat's head is in the ground, its rear end is vulnerable. By living in groups, these curious looking animals can take turns to, literally, stand guard for others. Since they live in burrows, meerkats like to bask in the sun to warm up, and as they need to hunt as well as fend off hunters who prey on them, meerkats have evolved a society that allows some members to forage for food while others keep guard. Meerkat females will even 'babysit' a mother's young while she goes out to forage. Everyone, though, has to take a turn at sentry duty. When one is exhausted after about an hour's watching, another immediately comes up to trade places.



E. Robson

Richard Packwood/Oxford Scientific Films

***African hunting dogs** are very social creatures, hunting in packs of up to 60 or more. Their sense of smell and hearing is highly developed and they usually target antelopes or even larger game for their prey. Such is the intricate organization and heirarchy within the group that it is possible a lone dog would not be able to survive on its own.*



Peter Davey/Bruce Coleman Ltd

***A bull elephant,*** *although large in stature, exists in a matriarchial society, with the oldest female taking the role as leader of the pack. The social bond between cow elephants is exceptionally strong, but between the young bulls there seems to be little co-operative behaviour.*

Hans Reinhard/Bruce Coleman LTD

***The wild cat.*** *Almost from birth the male works out strict boundaries across which other cats step at their peril. If an aggressor does successfully penetrate rival territory without attack, the boundary lines are redefined.*

Hans Reinhard/Bruce Coleman Ltd

***A rooster*** *crows to show that he is confident about his position at the top in the pecking order. Birds establish a hierarchy to determine individual roles within groups, which helps to maintain an orderly continuation of the species.*

***The male lion*** *rarely hunts, although the males eat first. Most prides contain two males, who protect the pride's territory.*

Ardea

***Moose*** *lock antlers to determine a dominant male. The winner will gain access to the harem of females, which will ensure a continuation for his line. Antlers are almost exclusively sported by the males.*

K. W. Fink/Ardea

***The silver-back male*** *gorilla is twice the size of the five females in his harem. It is the bond between him and his 'wives' that keeps the group together.*

Steven C. Kaufman/Bruce Coleman Ltd

Peter Davey/Bruce Coleman Ltd

***The king cobra.*** *Less deadly than the female, the male is more impressive. Raising its magnificent hood, it hypnotizes its victim before striking.*

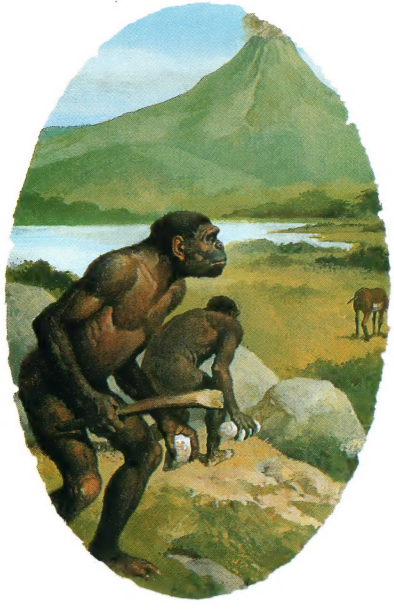
Zefa



Still from *Gorillas in the Mist*. Warner Bros

***Family life** is important for humans and gorillas alike. As primates they share a common heritage, and both are highly social animals who prefer to band together in groups.*

# THE EVOLUTION OF MAN



***Australopithecus** lived about three to four million years ago in Africa. He stood just over one metre high, had a rolling gait, large jaws and teeth, and a brain, about 500cc, no larger than that of an ape.*

**OF ALL THE ANIMALS IN THE modern world, humans alone change the environment to suit themselves rather than adapting to their environment. Yet early human history is one of adaptation, and one of the most decisive events in Man's evolution was the development of bipedalism – walking upright on two feet.**

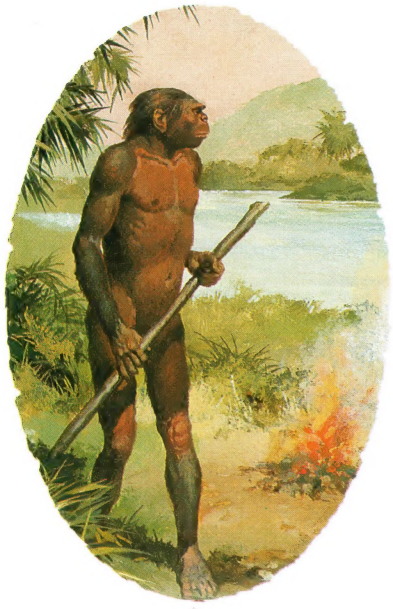
The footprints of a small group of Man's early cousins, found in a layer of dried volcanic mud in Tanzania, Africa, 3.75 million years old were made by two adults and a child. Named *Australopithecus*, their brains were no bigger than those of apes, but there is a possibility that they used very simple tools, such as sticks and naturally-shaped river pebbles.

Man's ancestors were primates, able to hold things between fingers and thumb, with two mammary glands on the chest, eyes in the front of the head, and a covering of hair. They lived in the thick forests of Africa. Between 10 and 7 million years ago, a climatic change caused the thinning of these forests, and the emergence of wide grasslands and shrublands.

## Evolutionary split

Some of the primates who had lived in the trees – using their hands with their opposed thumbs to swing from branch to branch – now began to emerge from the shrinking forests, possibly due to the pressure of competition for food. Those primates that would evolve into the African apes, the chimpanzees and gorillas, stayed among the trees, developing their knuckle-walking gait, and dividing their time between trees and the ground. Others, evolving into grassland dwellers, developed the upright stance and two-legged walk that characterizes humans.

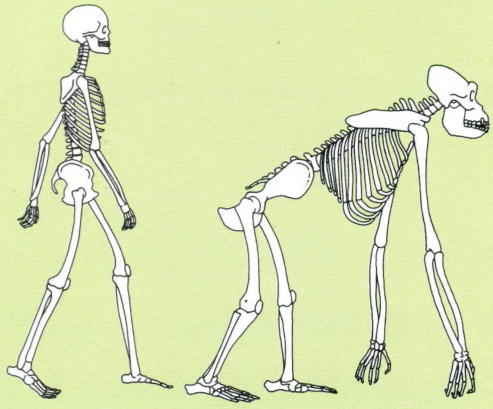
Out in the open, they lived mainly on shoots and fruits, and covered



***Homo erectus*** *lived over one million years ago. The heavy-browed creatures cooked their food on fires which helped them to survive the cold.*

## SKELETAL DEVELOPMENT

The skeletons of Man and gorilla are adapted to their differing style of motion. The long pelvis of the gorilla accommodates the muscles necessary for travelling on all fours, and his fingers are curved inward for knuckle walking. Man, with his striding gait, has a much shorter pelvis, and his skull is balanced on top of the spinal column, unlike that of the gorilla which is held forward. The gorilla also has strongly developed big toes which he uses to grasp branches.



long distances, stripping bushes and trees as they moved. They ate very little meat, but may have supplemented their diet by scavenging what predators had left, or picking off the occasional sick or very young animal from a grazing herd.

### Natural air conditioning

One strong possibility is that walking upright served the very practical purpose of keeping them cool. The move from dark forest shade to sun-blasted open country must have caused severe problems for creatures without an advanced cooling system. By standing upright, their bodies absorb 60 per cent less heat than creatures who walk on all fours and expose a far greater body area to direct sunlight.

As the evolutionary line that included the Australopithecines died out, another line was already in progress. Coming from the same origins, but with a larger brain half the size of modern Man's – *Homo habilis* (handy man) probably emerged as a separate species sometime over two million years ago. He was a toolmaker, with developed manual skills for holding, flaking and shaping tools from rocks and pebbles. Like their predecessors, *Homo habilis* originated in Africa, well before Man migrated into Europe and Asia.

### The hunter

With stone-tool technology came the ability to kill and cut up large animals, and Man started to include more meat in his diet.

The larger brain of *Homo habilis* included a significant enlargement of the brain region known as Broca's area, which is associated with language. He was a socially organized creature, arranging, for example, collective hunting trips. The females and children were possibly left at a home base while the men went out.

Each increase in brain size is reflected in a faster adaptation to changing conditions, and a widening of skills. The fossil record from 1.6 million years ago shows evidence of a more advanced species, known as *Homo erectus* (upright man). He had a brain capacity of 1,000cc, compared to *Homo habilis*'s 800cc, and modern Man's 1,400cc. *Homo erectus* was a more

## PRECISION GRIP

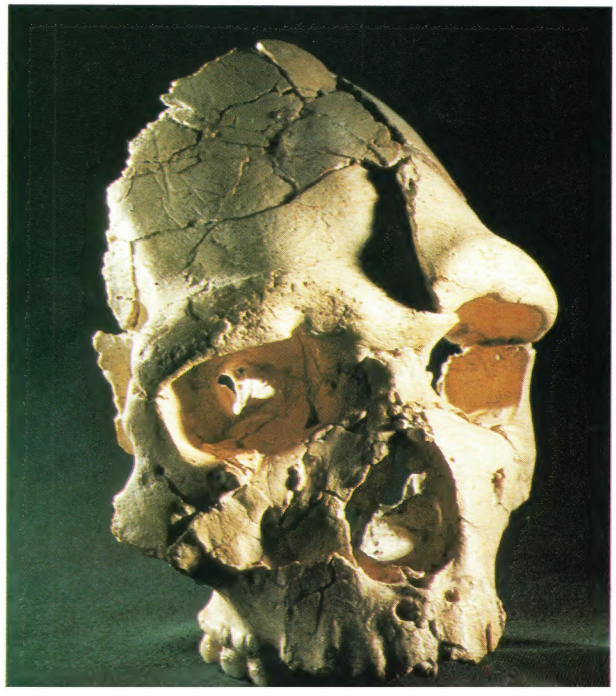
Peter Davey/Bruce Coleman Limited

**Human**

**Chimpanzee**

The chimpanzee can use simple hand tools, but the shape of his hand limits his skill. His hand closely resembles that of a human, but the absence of a fully opposable thumb means that the chimpanzee has no precision grip. Although his fingertips act as delicate instruments of touch, his inability to grip means he cannot use tools with accuracy.

***Tautavel man,*** *whose broken skull was found near Perpignan in southern France, was an example of* Homo erectus. *This group were proficient hunters with strong nerves and quick reflexes. Their ability to feed, clothe and keep themselves warm ensured continued evolution of the human race.*



M. Oster Collection/Musee De L'Homme

***Neanderthal** man existed about 100,000 years ago. Although primitive in appearance, his hunting techniques showed there was a great deal of communication within the group.*

sophisticated tool-maker, and a proficient hunter. He was also the first fire-user.

It was *Homo erectus* who took the human species out into the wider world, out of the African cradle, and into Asia and Europe. His remains have been discovered in North Africa, Greece, Hungary, France, Germany and England in the West, and Indonesia and China in the East. Remains range in age from 1,000,000 to 200,000 years old, although the younger remains have some indications of the next shift, to *Homo sapiens* (wise man).

Neanderthal man – *Homo sapiens neanderthalensis* – was established across Europe, the Near East and Central Asia 100,000 years ago, and died out quite abruptly 35,000 years ago. He had a large brain, and a very stocky, muscular body. His teeth and nose thrust forward, his brow sloped back, his brow ridges were prominent, and his teeth were big.

Despite his appearance, he was highly intelligent, a very skilled tool-maker, and made clothes. He was a thinker, with developed ideas about life and death, who performed ritual burials for the dead.

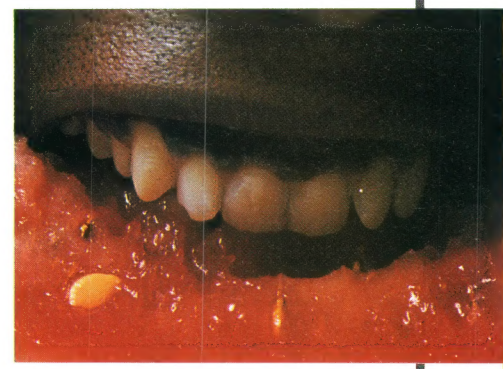
## Moving forward

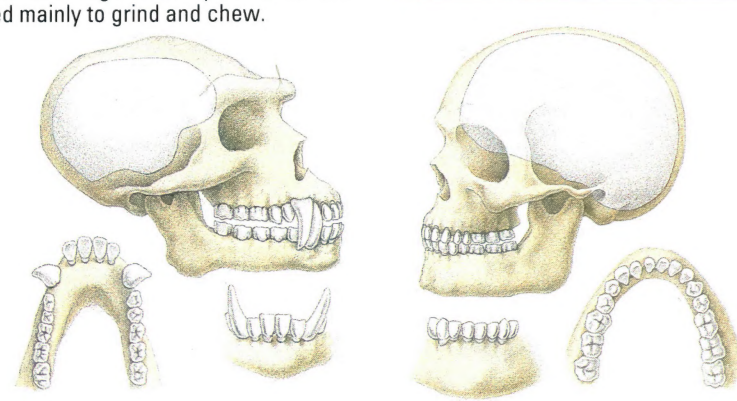
The most recent stage in Man's development, *Homo sapiens sapiens*, may have descended in part from some advanced Neanderthals, or may have stemmed from a completely separate *Homo spaiens* line from outside the main Neanderthal area of operation. Most likely, there was some interbreeding with Neanderthals even if modern Man took over from them, exterminating them in the process. Modern Man had colonized most of the globe by 30,000 years ago. A great land bridge between Siberia and Alaska periodically emerged from the sea in the course of the last Ice Age, as sea levels rose and fell again. Human migrations into North America probably accompanied other predators such as lions and wolves, following herds of grazers such as bison, elk and mammoth.

Man may have reached Australia as early as 50,000 years ago. But to

## JAW SHAPES

The jaws of Man and ape show marked differences. Man's teeth form a rounded arcade, while in apes they form a rectangular shape. Apes also lack the characteristic human chin. In Man, the gradual shortening at the snout has been accompanied by a reduction in the size of the teeth, especially the canines. Formation and shape of the teeth also differ. Both sets of teeth are adapted to their respective diets. Man's teeth are suited to the slicing action needed to cut through meat or fruit, while the vegetarian ape's teeth are used mainly to grind and chew.





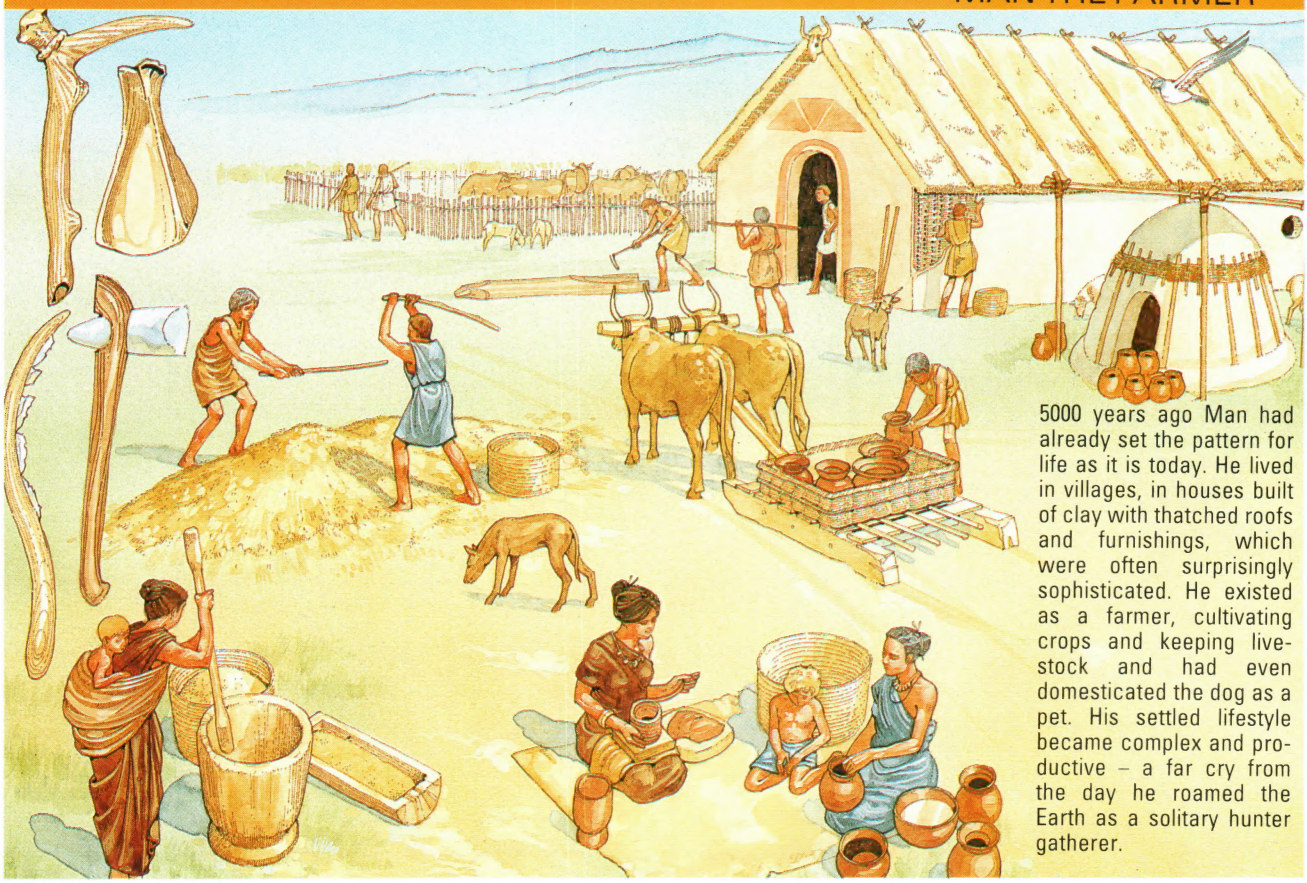
**Chimpanzee** **Human**

Jan De Wit/Zefa

Timothy Beddow/Daily Telegraph Colour Library

***The cave painters** seemed to go to great lengths to hide their art. One theory is that the paintings may have been done to invoke good luck and needed to be kept secret from hostile tribes.*

***Cro-Magnon man** lived a mere 30,000 years ago. He looked quite similar to modern-day Man. Capable of manufacturing basic tools, he reached a high level of development.*



John James

5000 years ago Man had already set the pattern for life as it is today. He lived in villages, in houses built of clay with thatched roofs and furnishings, which were often surprisingly sophisticated. He existed as a farmer, cultivating crops and keeping livestock and had even domesticated the dog as a pet. His settled lifestyle became complex and productive – a far cry from the day he roamed the Earth as a solitary hunter gatherer.

do so – despite lowered sea levels due to the Ice Age – he must have made sea journeys between the islands that form a chain across the Timor Strait.

The last Ice Age ended 10,000 years ago, and the climate became generally warmer. Man was poised on the brink of one of the most significant developments in his history. For two million years or more, he and his antecedents had been hunters and gatherers, wandering through wide areas following game, sometimes using seasonal camps or caves as staging posts in nomadic wanderings. Gradually, he had specialized in making certain tools, in hunting certain types of animal, in gathering certain plant foods.

His settlements became more sophisticated, and more permanent. A certain amount of crop cultivation was practised at scattered sites. In the Nile Valley, wild barley was cultivated at least 18,000 years ago, and horses had been domesticated in France 15,000 years ago.

## The first town

At last, Man embarked upon full-scale agriculture. The first major centre was the high-rainfall Fertile Crescent of the Middle East, stretching between Jordan and Iran. The first settlements associated with farming were established 10,000 years ago: sheep and goat bones indicate stock farming.

Another sign of settled farming was the development of pottery. Populations increased fast. The first known town in the world was Jordan, situated in the south of the Fertile Crescent, with a population of some 2,000.

At the beginning of this agricultural revolution the entire population of the Earth was perhaps no more than 10 million: 8,000 years later, at the beginning of the Christian era, it had reached 300 million, and was showing no signs of slowing down.

The settled life of farming, and the efficient control of food supplies, together with the support systems of a stable settlement, meant that far fewer infants died young from malnutrition and extremes of weather, and the old lived longer. The agricultural life also resulted in the first real accumulations of wealth in the form of food surpluses. It gave rise to the growth of trade, and the system of political alliances that would eventually lead to empire-building.


Paul Raymonde

Victor Englebert/Susan Griggs Agency

***The Yanomami Indians** are descendants of the earliest migrations to South America which took place 20,000 years ago. Their lifestyle has changed little for thousands of years.*